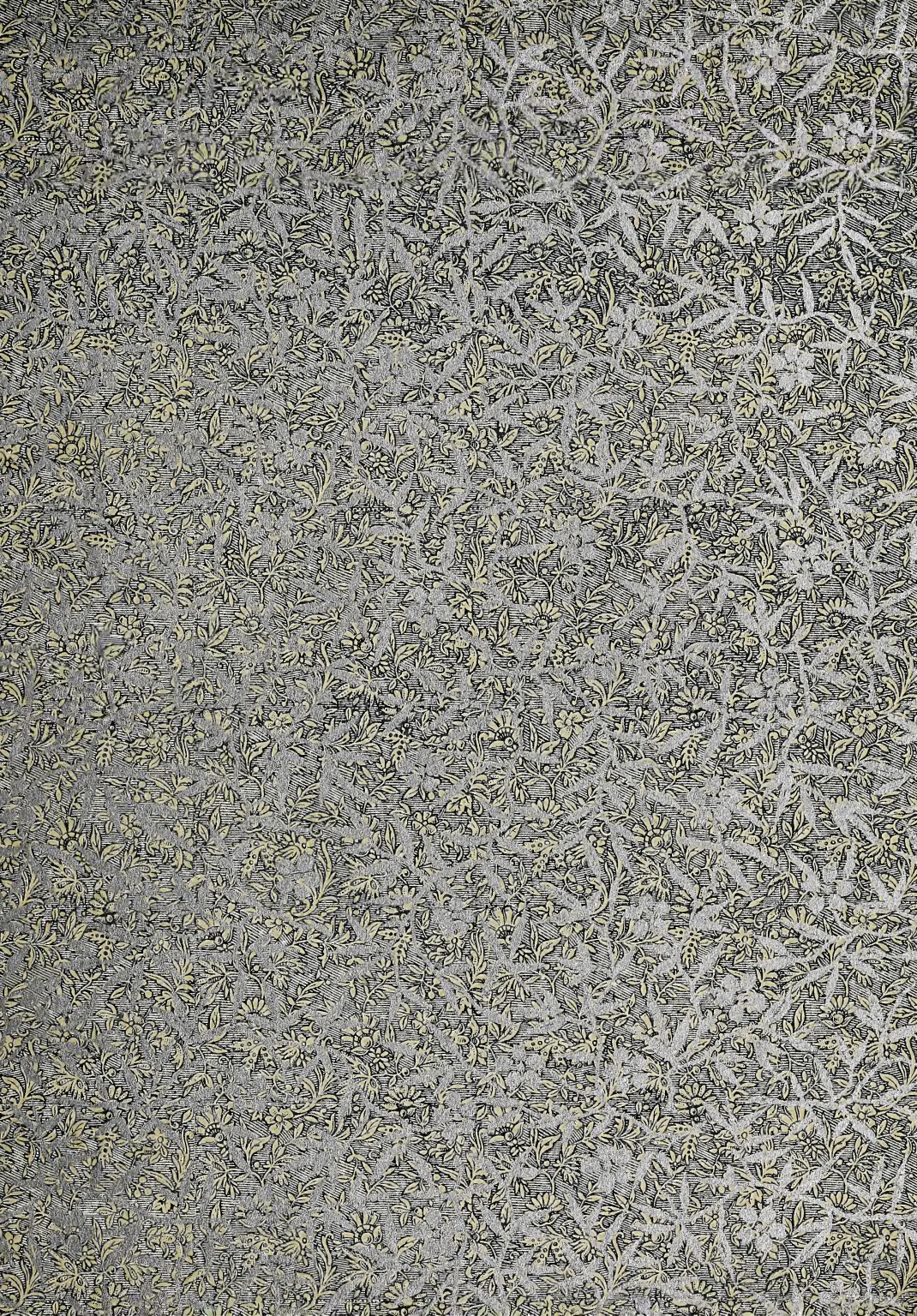
History of Composing Machines

By John S. Thompson



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History of Composing Machines

A COMPLETE RECORD OF THE ART
OF COMPOSING TYPE BY MACHINERY

Fully Illustrated

ALSO

LISTS OF PATENTS

ON COMPOSING MACHINES, AMERICAN AND BRITISH,
CHRONOLOGICALLY ARRANGED

BY

JOHN S. THOMPSON

CHICAGO
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Foreword

The interest taken in the articles published serially in The Inland Printer under the caption "Composing Machines — Past and Present," and the desire of many to preserve them in a more convenient form for reference, has induced the author to revise these articles, and the result is this volume, which is designed to be a complete history of the art, and will, it is hoped, be found helpful and instructive to all those who wish to be informed on this important subject.

It has been impossible to minutely describe every device which has been patented, though an effort has been made to follow each step in the art which marked a distinct change or advance.

The list of patents issued both in the United States and Great Britain, given at the end of the book, will be found valuable for reference by inventors and students of the history of composing machinery.

THE AUTHOR.

Chicago, August 22, 1904.

A U T O M A T I C J U S T I F I C A T I O N

The earliest practical combined 'automatic' typecasting and composing machines that would produce from the keyboard a justified line were both produced in the same year.

1885 Merganthaler's linotype p.100
1885 Lanston's monotype machine pp.120-121

Note-Merganthaler had the above machine in 1884 but without a practical system of justification

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Introduction

TYPESETTING by machinery has done more to advance the cause of universal education than any other one factor since the art of printing was invented. Mechanical composition has caused a reduction in the cost of printing books, newspapers and magazines, and thus placed within the reach of the masses the means of education. The brains of many skilful inventors and vast fortunes in money have been employed in the work of developing an acceptable substitute for hand composition. When it is remembered that for four hundred years following the invention of movable types no other method of composing them but by hand was known, the strides which have been made during the past few years will be more fully appreciated. Although the first mechanical composer for type was invented in 1822, it was many years later before a practical device was put into operation, and not until 1885 that a genuine labor-saving composing machine was offered to the printing world. The solution of the problem of mechanically composing type gave a tremendous stimulus to printing and made possible the

publication of many books and newspapers which otherwise would never have been created.

The route over which pioneers in any line have traveled is always of historical interest, and the milestones which mark the progress of the typesetting machine are found in the records of the patent offices of various countries. Although hundreds of machines for composing type mechanically have been patented, but few were actually constructed, or, if built, failed either to perform their functions or do so economically.

American inventors have supplied the world with typesetting machinery. The first typesetting machine was the invention of an American; every style of machine in commercial operation to-day in any part of the world is of American invention. The Linotype, the Typograph, the Monoline, the Monotype and Simplex machines are found in all quarters of the globe. Machines of European invention are in but limited use in their own country.

In solving the problem of mechanical composition, inventors, first confining themselves to the construction of devices to mechanically assemble the types of Gutenberg, have since strayed far from the beaten paths, and to-day their inventions are classified into groups according to the means employed to accomplish the final result — a typographical printing surface. Under these headings we have, first, those machines which compose individual type, some of which are equipped with automatic typecasters, distributors or justifiers; second, machines which use male or cameo matrices for the indentation or

impression of soft material, casting lines from the matrices so formed; third, slugcasting machines; fourth, typecasting machines controlled by perforated paper strips; fifth, transfer machines.

Despite the many systems outlined above, there are on the market of the United States to-day but four styles of machines — the Simplex, an individual typesetting machine, using regular foundry product; the Monotype, a typecasting machine, controlled by perforated paper strip; and the Linotype and Linotype Junior, slugcasting machines. Of the entire total of eight thousand machines in use in this country, over seven thousand are Linotypes. In Canada are found, in addition to these, Typograph and Monoline machines — both slugcasters.

Mr. Theo. L. De Vinne, whose personal experience with various forms of typesetting machines was probably as extensive as that of any printer, wrote, in 1874, in concluding a review of the then existing typesetting machines:

"A careful review of what has been done, and of what is promised in the way of typesetting machinery, gives us no reason to believe that compositors will ever go out of fashion, or that automatic machinery will supplant brains. The man must be master of the machine. But there is every reason to believe that, at no distant date, some simple form of mechanism will be devised that will do the typesetting part of the work much quicker than it can be done by hand. Like all successful inventions, it will do chiefly the drudgery of the labor. It will not deprive the compositor of work, but will compel him to work more

intelligently. The compositor of the future will have to be, from the necessities of the case, an abler man than the average compositor of to-day."

It is apparent that most, if not all, the improvement made in mechanical typesetting has been accomplished within the last twenty years. Before 1885 there was no automatic justification of individual type, and not until then was there any successful substitute for the product of the typefounder. Since then automatic justification has been achieved by several methods, while the variety of operative typesetting machines gives a wide range of choice. Slug machines have been in high favor since their invention, but there is at the present time an apparent reversion to individual type machines, which have reached a high state of perfection within late years. The most promising of this class of composing machines are those which cast their own types as needed, composing and justifying them and delivering to the galley a line of justified single types, capable of manipulation to meet the needs of tabular and high-grade bookwork. Individual types may be said to be essential to economical production of this class of printing and the machine of the future will unquestionably be one which casts, sets and justifies single types in one machine and with but one attendant.

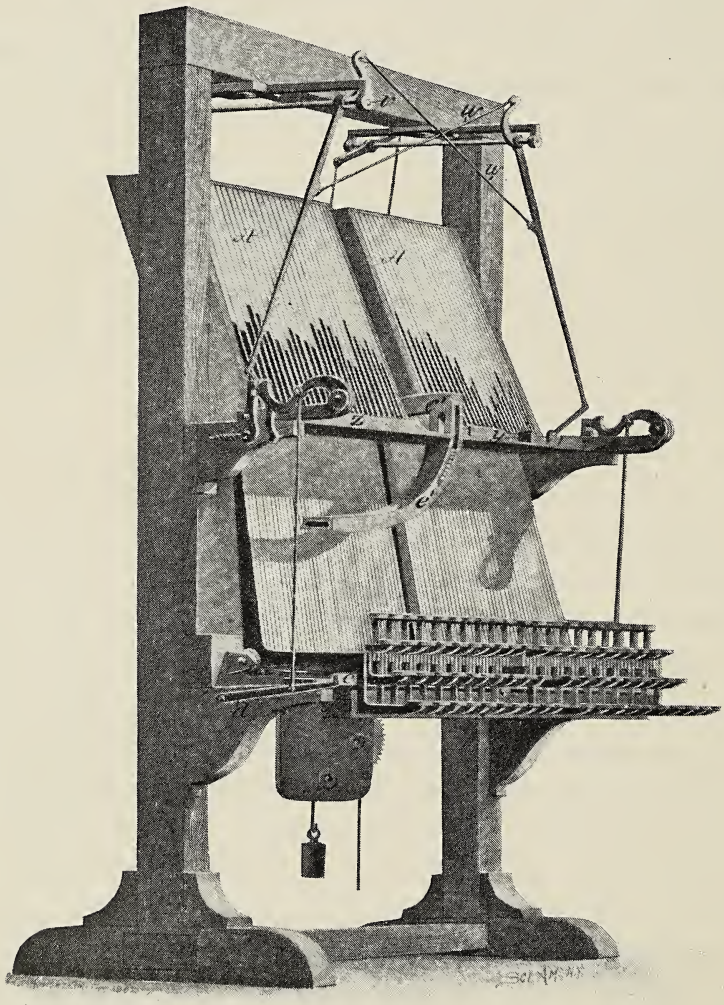
Individual Type Machines

Single-type composers, by which is meant those machines which handle regulation foundry type, comprise a vast number and are the oldest of all forms of composing machines. There are in use to-day machines of this class invented as far back as 1869. Successful devices, however, date from 1880, when distribution and composition were satisfactorily combined in one machine. Later machines of this class combined the operations of setting, justifying and distributing.

CHURCH'S TYPESETTING MACHINE.

To Dr. William Church, of Boston, Massachusetts, belongs the honor of patenting the first operative typesetting machine, he having, in 1822, taken out an English patent for a machine, which, though crude and clumsy, was operated to some extent. The type was arranged in inclined channels mounted in a wooden frame, and by the operation of a keyboard was ejected on to a horizontal plate, where a pair of rocking arms, set into motion by the movement of the key levers, swept the type to the center, when it was thrust downward into a collecting tube, and from thence removed and justified into lines in the usual manner.

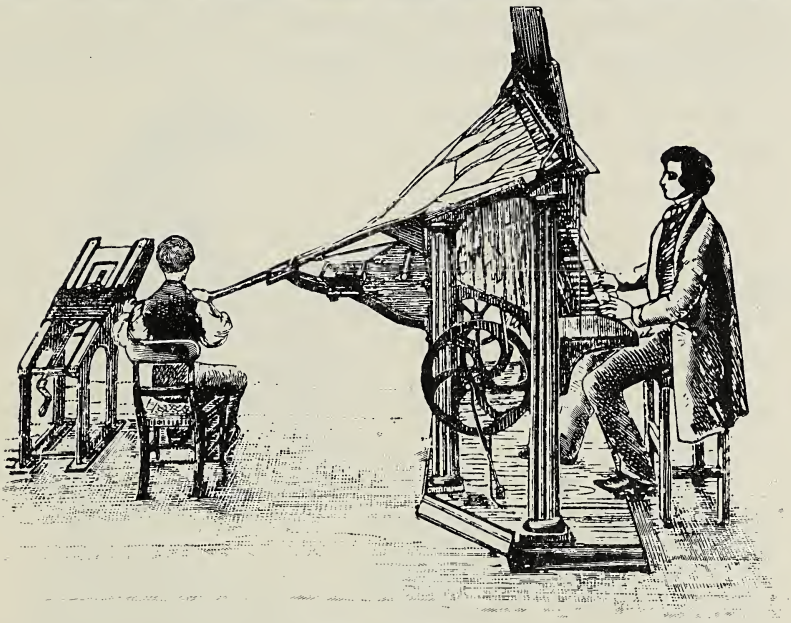
No power was needed to operate this typesetting machine, the rocking arms being connected to a clock mechanism, the operation of the keyboard releasing the train of gears and this causing the movement of the arms, which swept the type to the central collecting tube.



CHURCH'S TYPESETTING MACHINE.

THE "PIANOTYP."

The next improvement in typesetting machinery was made by Young and Delcambre, who, in 1840 brought out their machine, the "Pianotyp," which was used in France and England in a small way.



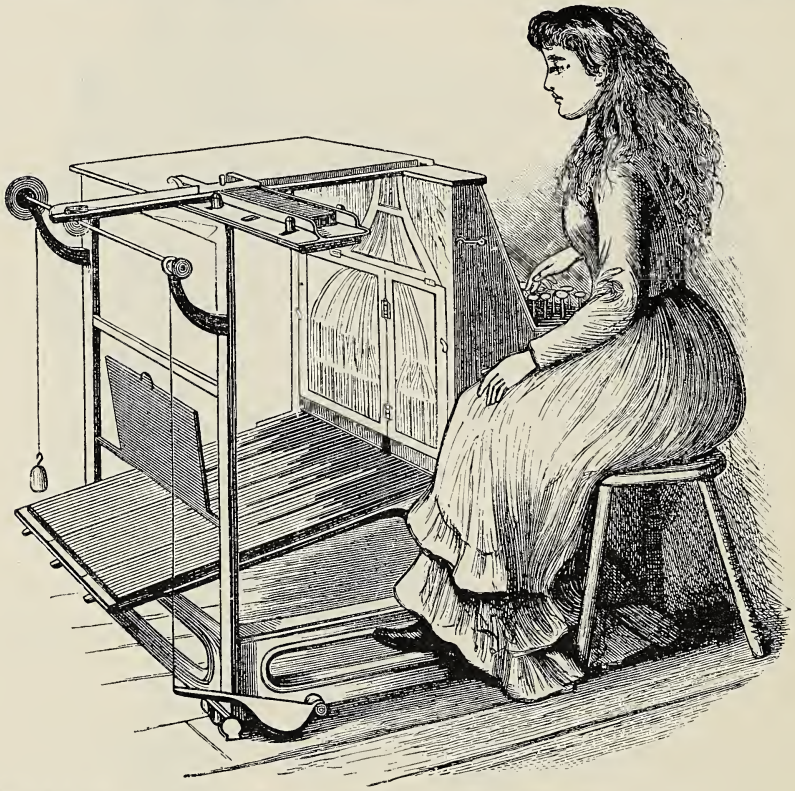
THE PIANOTYP.

In this apparatus the type was released into converging grooves, a second operator justifying the matter into lines.

CLAY AND ROSENBORG'S MACHINE.

In 1840 Clay and Rosenborg patented a typesetting machine in England, which also went into use. A distributing machine was also provided which was practically a reversed composing machine, the operator of which, by reading the type as it passed along and touching corresponding keys of a key-

board, caused the letters to be distributed into separate channels. The matter was placed on a galley on top of the machine, a pressure device pushing the type forward as fast as the lines were distributed. Behind the first letter was a steel pusher, which separated the type letter by letter as the keyboard was operated, causing it to be advanced



KEYBOARD DISTRIBUTING APPARATUS.

into a channel provided with switches, which conducted the type into its proper compartment. The switches were operated by the depression of the keys. The machines were exhibited in New York in 1843.

BENIOWSKI'S DISTRIBUTION SCHEME.

A unique method of distributing type is disclosed in the patent granted in England to Bartholomew Beniowski in 1846. He proposed to mark each letter on four sides and the foot with the character it bore on the face, so it could be distinguished at a glance however it lay, the upper and lower case letters being denoted by making them of differing colors. The spaces and quads were of wood and iron, the different sizes of different colors. To distribute the type it was loosely spread out in a tray and a magnet passed over the type to pick out all the iron spaces. Water was next poured over the type, causing the wooden spaces to float on the surface, and they were next removed. The type were next sorted according to color and finally sorted by letters into appropriate receptacles for a composing machine.

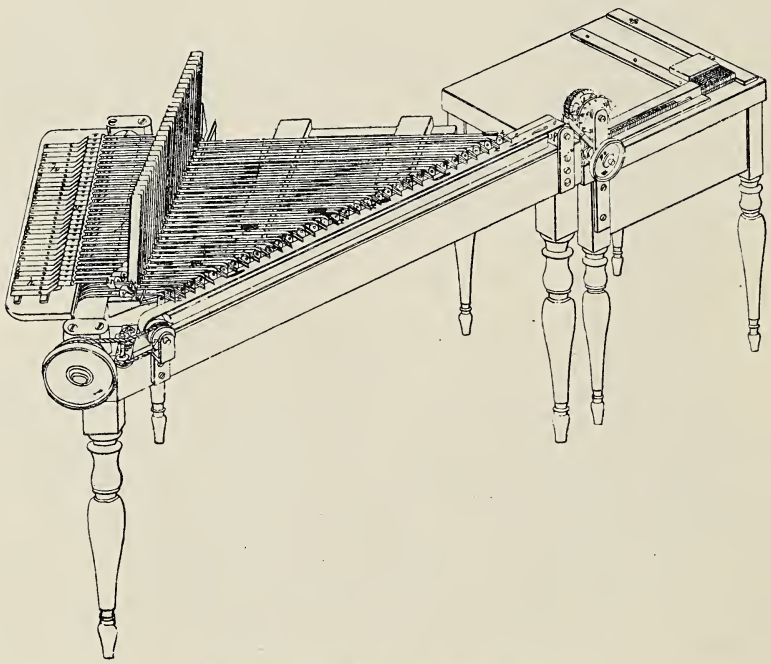
SORENSON'S TYPESETTER.

Distribution of type by means of special nicks was proposed by E. R. Gaubert in England in 1840, and the idea was successfully employed by Christian Sorenson, of Sweden, in his machine, invented in 1851 and exhibited at the World's Fair in 1855. Sorenson's machine was a combined setter and distributor, his plan being almost identical with that employed by Joseph Thorne thirty years later. He used two cylinders, one above the other, the upper one rotating and carrying the dead type, which, when the combinations of nicks in the type matched the corresponding ribs or wards at the channel entrances, fell into the channels of the lower or composing cylinder.

The price asked for this machine was $1,400. L. P. Coulon, in 1856, patented a similar device.

MITCHEL'S COMPOSING MACHINE.

The first patent to be issued in this country to an American for a typesetter was taken out by W. H. Mitchel, of Brooklyn, New York, August 30, 1853. A number of these machines were constructed, one office in New York, that of John F. Trow, having at



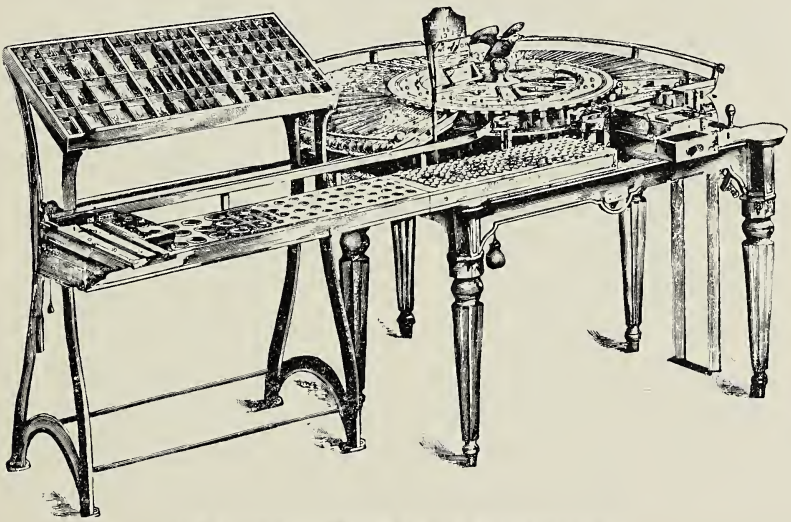
MITCHEL'S COMPOSING MACHINE.

one time twelve in operation. The Mitchel machine was probably the first typesetting machine ever put into practical commercial use. A distributor was provided with this machine, which, like the composer, was not entirely satisfactory. In this machine

the type was arranged in upright tubes and the bottom letter ejected by a plunger whenever its proper key was struck by the operator. The letters were conveyed on their own belts or tapes, each one of which was of different length, to a general receiving belt running diagonally. This belt conveyed the types to the receiving point, where the second operator, using a "grab," divided the composition into lines and justified them.

ALDEN'S SETTER AND DISTRIBUTOR.

A most interesting machine was that of Timothy Alden, who, in 1857, produced a machine which was also put into practical use in New York city, where



THE ALDEN TYPESETTER AND DISTRIBUTOR.

it was employed for many years. He arranged his type channels horizontally in a semi-circle, mounting in the center several jaws, which swept past the ends of the channels with a rotary motion and

grasped the type released by the operation of the keyboard and swept it to the central delivery tube, where it was assembled and subsequently justified into lines by hand. A later improvement combined with the setter an automatic distributor, the type being specially nicked. Four thousand ems per hour could be set on the Alden.

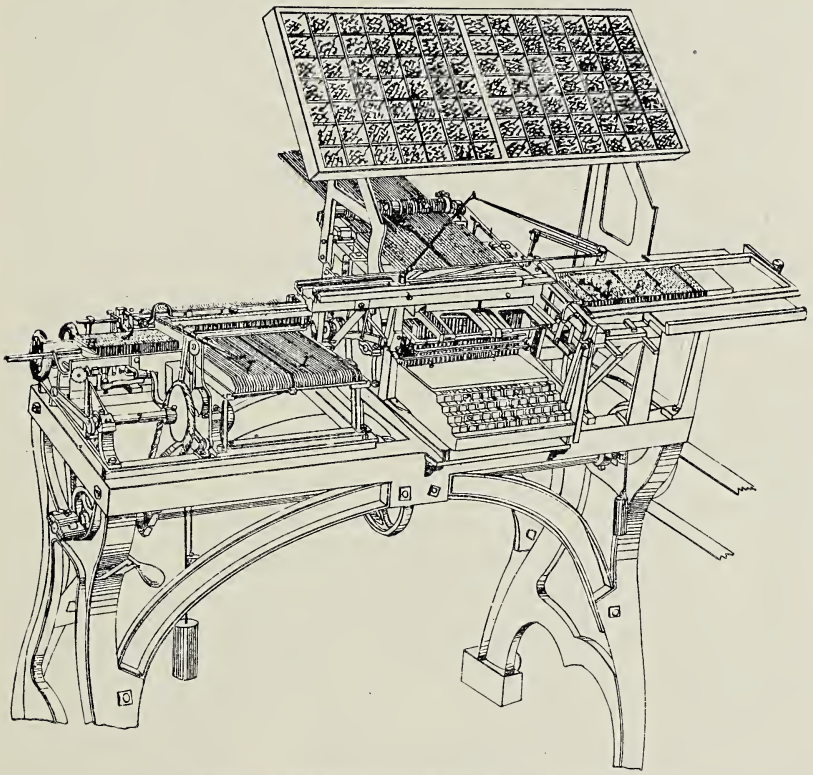
MACKIE'S "PICKPOCKET."

William Martin is shown to have been the original inventor of the method of controlling the action of a typesetting machine by perforations in a strip of material, which he claims in a patent issued to him in England in 1849. This is an application to typography of the invention of Francis Jacquard, which he perfected to weave silk, and the method has since been employed in several other industries. It was not, however, till 1867 that the idea was successfully employed, when Alexander Mackie introduced it in his typesetting machine. A keyboard was used to perforate a ribbon, which was then fed through a composing machine, where it caused the selection of ordinary type from their receptacles. The composer consisted of a circular frame, around the periphery of which were arranged type pockets. As the paper web was run through the machine, the disc was whirled around and a series of levers were allowed to drop through the perforations in the tape and cause a type to be released from its receptacle, it being then delivered into a channel where the lines were justified by hand. Several outlets were provided to permit a number of justifiers to be employed.

The Manchester (England) "Guardian" was composed by these machines, where they were dubbed "pickpockets."

HOUSTON'S SETTER AND DISTRIBUTOR.

W. H. Houston constructed a typesetting and distributing machine in 1868, after ten years of experiment. In this machine, the distributor and setter



HOUSTON'S COMBINED TYPESETTER AND DISTRIBUTOR.

were separate and distinct, though combined in the apparatus. The type was specially nicked to permit distribution into the channels, which were, when full, removed and placed in a horizontal position in

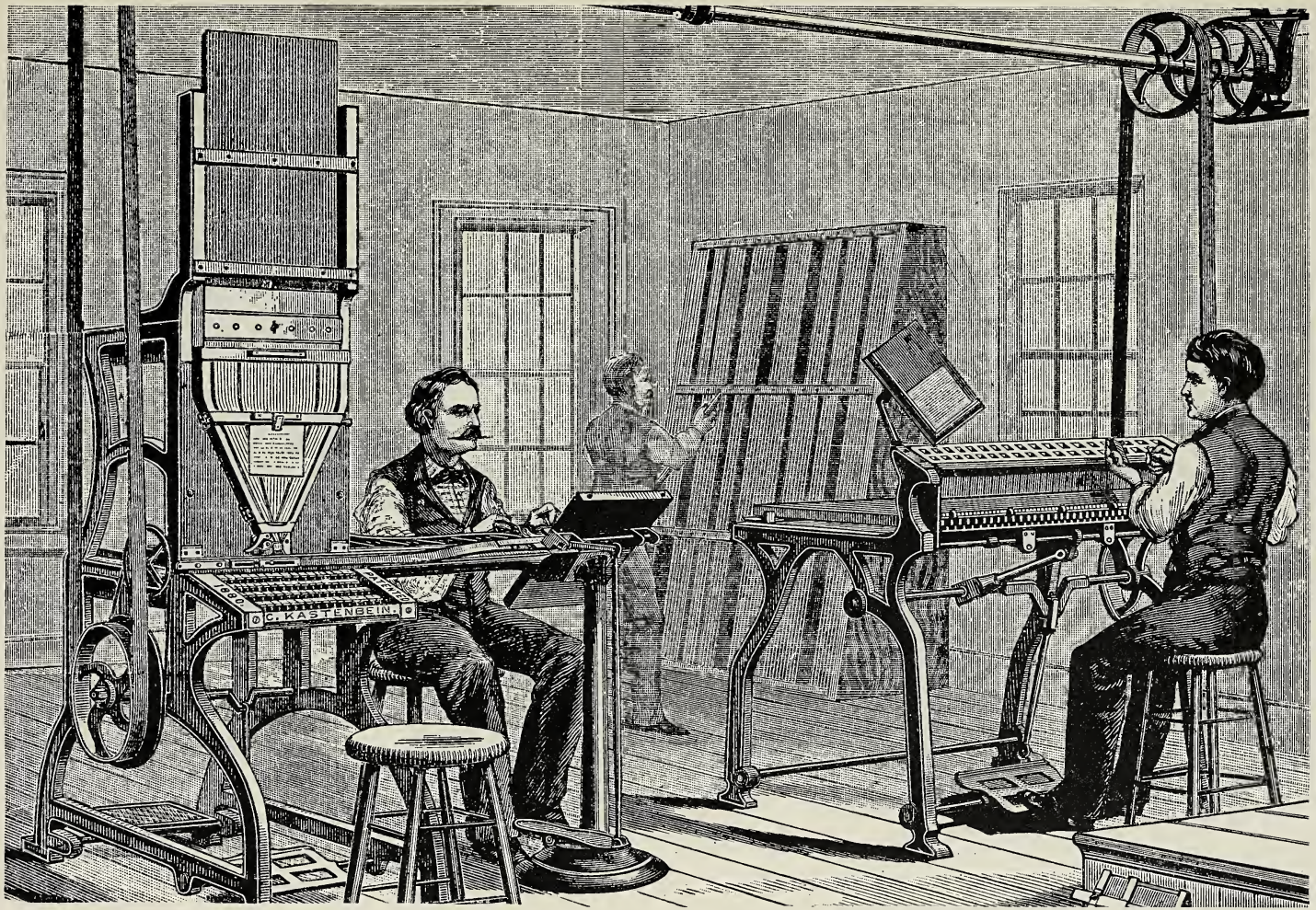
the composing section. Followers in each channel pressed the type forward, the usual keyboard arrangement being used to assemble them. A type case was mounted on brackets above the machine to provide extras, sorts, spaces, etc. Justification was done by hand.

THE KASTENBEIN.

In 1869 Charles Kastenbein patented in England a machine which showed a number of improvements. A distributor was also provided with this apparatus, the operator of which distributed the type by hand into hoppers, where it was assembled into channels ready to be placed in the composing machine. Power for both machines was supplied by the operator working a pedal. The London "Times" at present uses this composing machine, the type, however, not being afterward distributed, as it is the product of the Wicks Rotary Typecaster, and is furnished daily, and after once being used is remelted. The manufacture of the Kastenbein, a view of which is here shown, has long been discontinued. Several machines of this pattern found their way to this country and were used for a time with indifferent success.

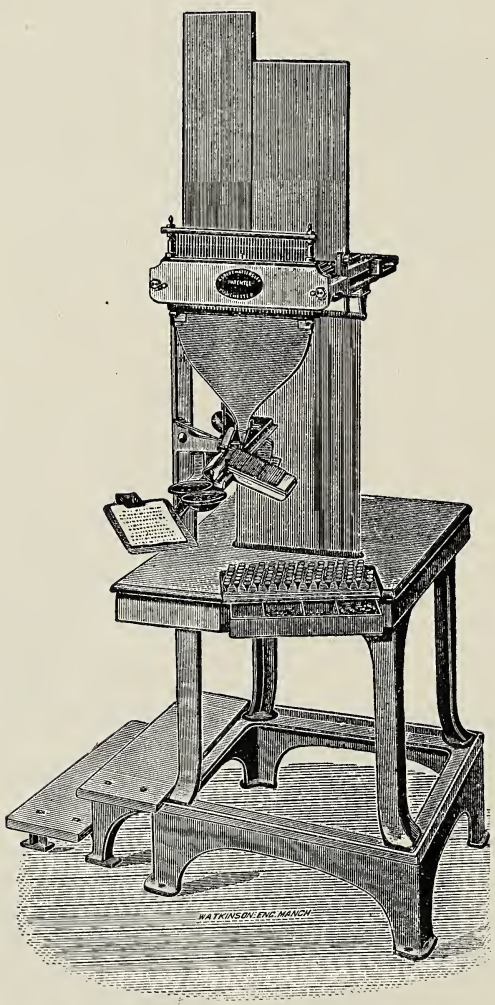
IRON TYPE.

Thomas J. Plunket, of New York city, in 1871 patented a method for setting type which was unique in its conception. He claimed the use or employment in a typesetting machine of electromagnets for collecting or carrying the type from the channels, which



KASTENBEIN SETTING AND DISTRIBUTING MACHINES.

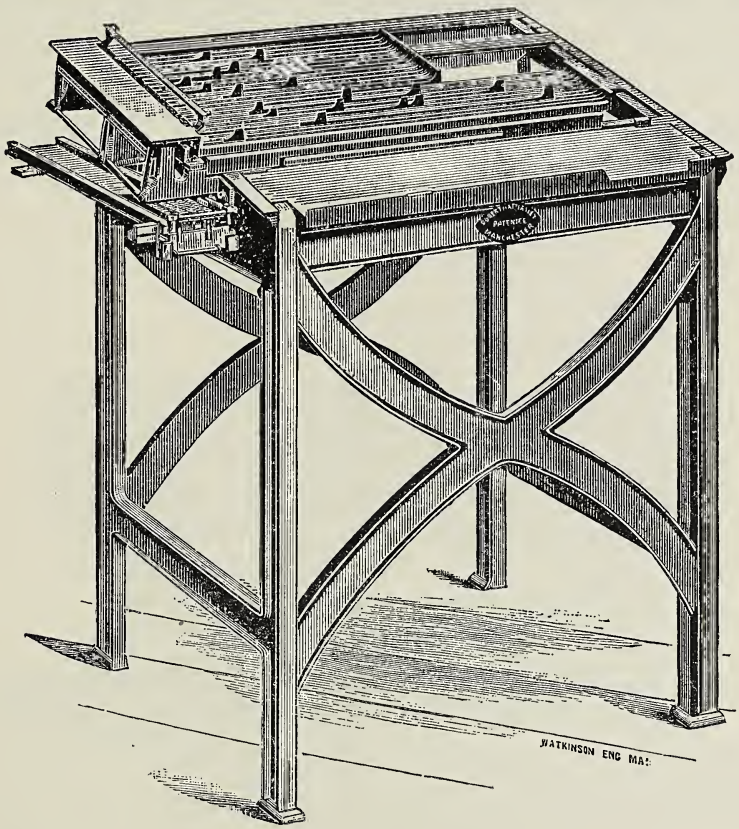
were mounted in a circle. The type was released by depressing keys, the magnets picking them up, swinging around the circle, and depositing them in the line. As type metal is not attracted by magnets, this inventor must have contemplated nothing less than iron type.



HATTERSLEY COMPOSING MACHINE.

THE HATTERSLEY MACHINE.

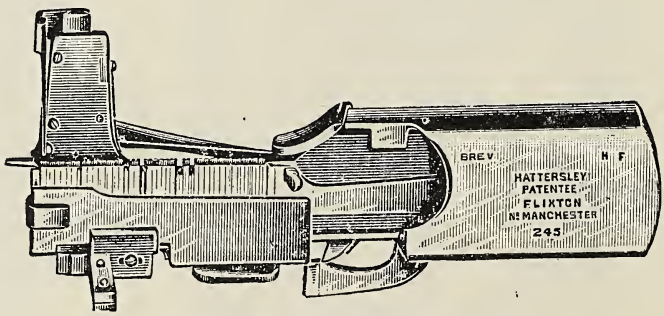
Robert Hattersley, of Manchester, England, in 1857 overcame many of the defects of Young and Delcambre's machine, and in 1872 brought out his



HATTERSLEY DISTRIBUTING TABLE.

machine. Hattersley machines are still being installed in England. The South Wales "Daily News" has seventeen of them in operation. The fact that no power whatever is required to run Hattersley machines makes them unique in this respect. They are constructed adaptable to two fonts of

type, and the change from one size to another can be made in half a minute. Any length of line can be composed up to forty-two ems. Composition is accomplished much as in other machines of this class, by a steel pusher ejecting the type from the channels when the keyboard is operated. The only notable difference in the operation is that, when a line has been completed, a bell rings and warns the operator, who thereupon justifies the line, afterward proceeding with the composition of the next line.



HATTERSLEY DISTRIBUTING STICK.

In 1872 the Hattersley distributor was invented. In this machine the empty type channels are placed on the distributing table. The operator is supplied with an instrument called a distributing stick, with which one line of type is picked up from the galley. Holding the stick in his hand, he reads the line and presents the stick before the appropriate channel, pushes a lever and the type is ejected into the channel. The type case, when full, is removed and placed in the composing machine. The price of a Hattersley composing and distributing machine is $1,700.

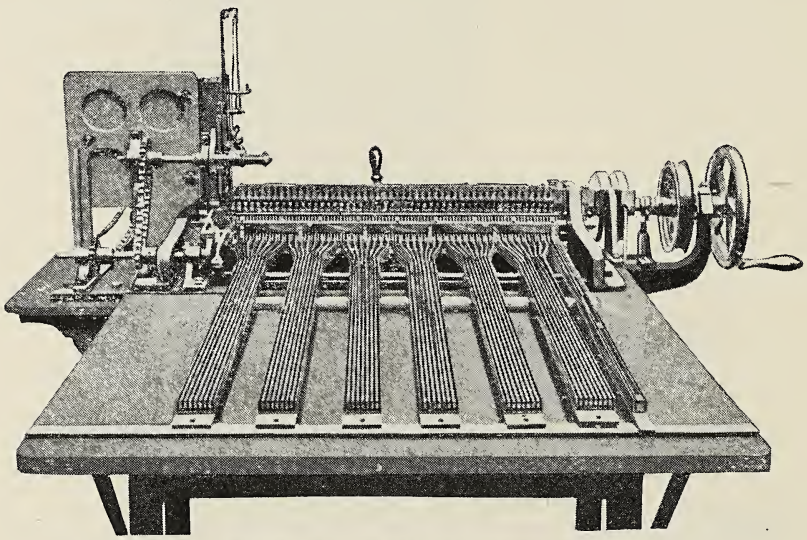
THE FRASER.

In 1872 Alexander Fraser, of Edinburgh, Scotland, brought out a typesetting machine which is still in use, in improved form, in one of the Government offices in Edinburgh. More than ten thousand pages of the 1888 edition of the Encyclopaedia Britannica

FRASER COMPOSING MACHINE.

were set on the Fraser machine. In an early form of this machine the type was contained in grooved trays on top of the machine, the type being pressed forward by weights. In the later machines built, the type

was placed in an inclined magazine and released into converging grooves in the face plate, they then dropping to the bottom of the chute and assembling in a line. A crank motion put into action by the operation of the key lever presses the assembling types forward. From six thousand to twelve thousand types per hour is the capacity of the Fraser, which requires two men, one to operate the

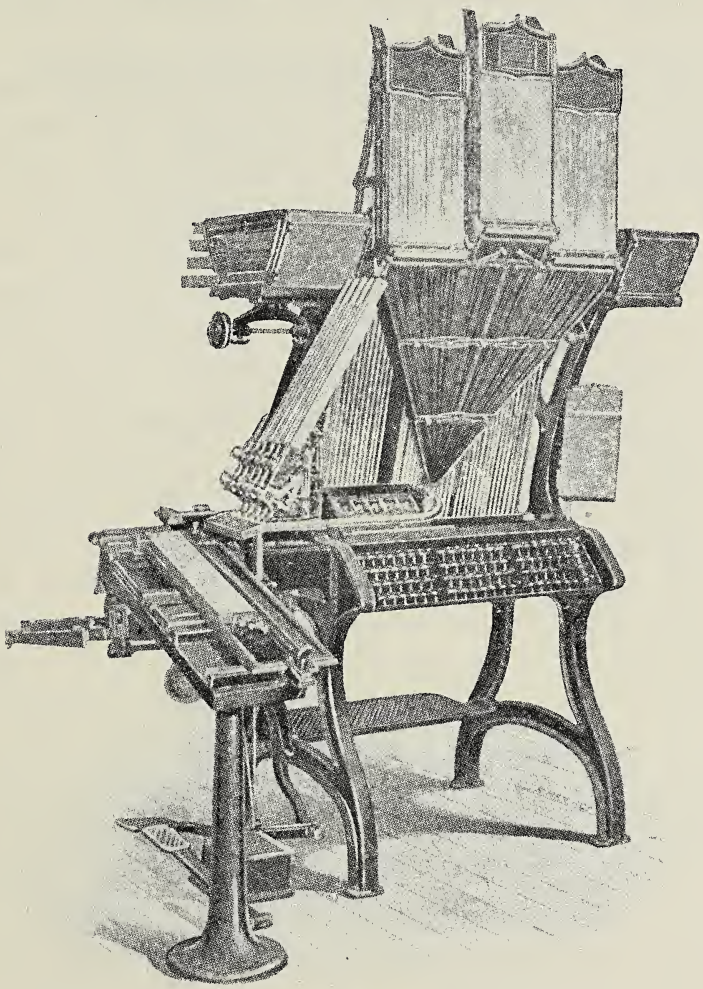


FRASER AUTOMATIC DISTRIBUTOR.

keys and another to justify the lines. The machine was sold for $700. With the Fraser machine a type-distributing device similar to that of Clay and Rosenborg's was employed. Later an entirely automatic distributor was designed for this machine, the type being fed line by line into the distributor and returned to separate channels by special combinations of nicks, these channels when full of type being transferred to the composing machine.

THE EMPIRE.

The "Burr" machine, of 1872, was the first American typesetting machine to come into universal

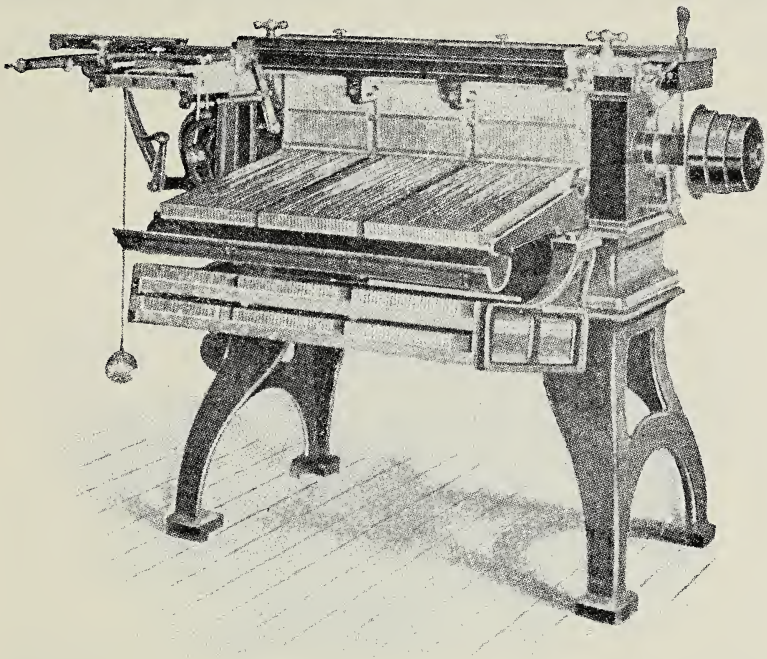


THE EMPIRE.

use. In 1880 the name was changed to the "Empire," and this machine may be found to-day in many American and European printing-offices.

In the composing machine, three cases, containing eighty-four channels, are arranged at the top of the machine, each in a separate cradle with glass fronts. The cradle can be rocked to a horizontal position when empty, and filled cases slipped into it and rocked back to the perpendicular position, the faces of the type being in view of the operator through the front glass. Behind the bottom of each channel is a steel pusher, which, at the depression of its corresponding key, forces the type from the case. The front plate of the machine is a series of converging grooves, one for each letter, cut in a metal plate, this grooved plate, with its glass covering, being set at an angle inclining backward, so that the glass really forms the bottom of the type channels. The type is assembled in a continuous line. A second operator, with an instrument called a "grab," draws toward him a portion of the assembled line and justifies it by substituting or adding the necessary thicknesses of type spaces to fill the measure. Convenient to his hand is a series of channels containing the various spaces, at the bottom of each channel thumb-pieces being arranged so that the pinching of them together leaves in the hand of the justifier the size of space desired. The only part of the Empire driven by motor is a small cam, which revolves in the raceway and keeps a clear space for the letters falling from the channels. Each machine is capable of composing two sizes of type, for instance, 7 and 8 point, 9 and 10 point, etc. The average output of the composing machine will vary from five thousand to six thousand ems per hour.

The automatic distributor of the Empire machine has a capacity of six thousand ems per hour, and requires the attention of a boy. The dead matter is placed on a galley and the machine lifts it, line by



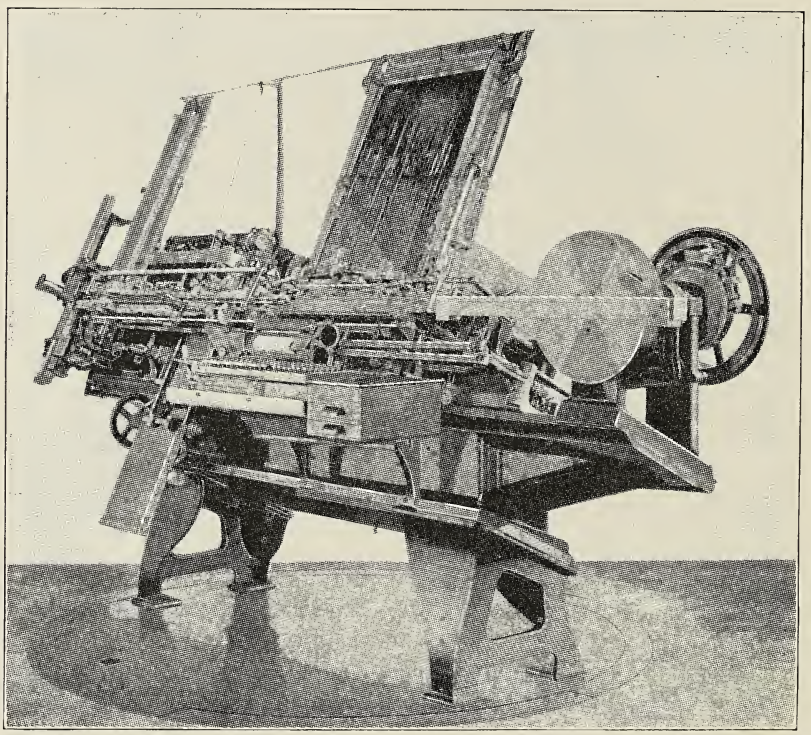
EMPIRE DISTRIBUTOR.

line, to the distributing channel, where the special nicks in the type allow it to be returned into a series of channels, which, when full, are removed and placed in the composing machine.

THE PAIGE COMPOSITOR.

Perhaps the most wonderful typesetting machine ever invented was the Paige Compositor, the product of the brain of James W. Paige, of Rochester, New York. Certainly no machine has a more interesting

history. Mr. Paige first conceived the idea for his typesetting machine in 1872, and in the years following conducted experiments with distributing, setting and justifying machines, a complete machine being constructed in 1887. In 1892 the apparatus was removed to Chicago, and two years later work



THE PAIGE COMPOSITOR.

was started on a commercial machine, which was installed in the office of the Chicago "Herald" in 1894. After several months' trial, during which time the machine was again partially reconstructed, work was abandoned and the apparatus, purchased by the Mergenthaler Linotype Company, was presented

to Columbia University, the earlier Paige machine going to Cornell University, at Ithaca, New York. Before the first Paige machine was constructed the promoters had spent $1,300,000. Probably another million was expended before the end came.

The history of the Paige patents is unique. The first application filed contained 204 sheets of drawings, with over a thousand separate views. It is said the attorney who first prepared the case received a fee of $10,000 with an allowance of $2,000 extra to pay for drawings. Examiners from the Patent Office were sent to Chicago, where a month was spent examining the working machine. This was an almost unheard-of proceeding.

Three patents were issued in 1895, one pertaining to the justifying apparatus, of which Charles R. North was joint inventor. The three patents contained 275 sheets of drawings, 123 sheets of specifications and 613 claims, all of which are now owned by the Mergenthaler Linotype Company. The application was filed in 1887 and was pending eight years, mainly owing to the work of examination by the Patent Office. One of the examiners died while the case was pending, another died insane, while the patent attorney who originally prepared the case also died in an insane asylum. It is estimated that the first edition of the Paige patents cost the Government $6 each, and the total cost of issuing the patents more than $1,000. The legal fees of the Government were only $35 on each patent and copies were sold at 5 cents each until the edition was exhausted. They are now held at a high premium.

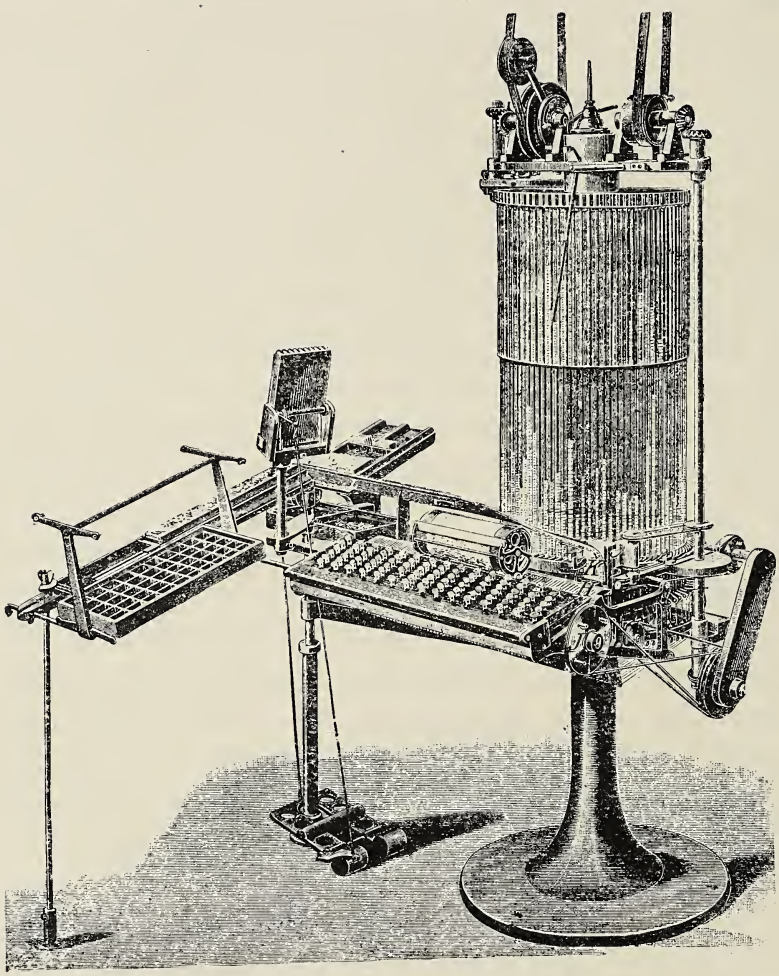
In every way the Paige was a most remarkable piece of mechanism. Its complications were such as to demand the attendance of experts, and the impossibility of training mechanics to the degree of skill required made it a commercial impossibility. There were about eighteen thousand separate parts, eight hundred shaft bearings, and cams and springs innumerable. The keyboard alone was the result of ten years of study, its 109 characters being so arranged as to permit whole words to be conveniently assembled at one stroke of the keys. The operator used every finger of both hands and brought down whole words at a time. Averages of 12,000 ems per hour were frequently made by operators who had but little experience. At the end of each word a word-key was struck, and at the end of the line a line-key was pressed, the operator immediately proceeding with composition, the machine meanwhile measuring the space occupied by each word, forwarding the line to the justifying mechanism, dividing the space in the line not occupied by words into the proper number of spaces, and inserting the spaces to accurately justify the line before pushing the line on to a receiving galley, leaded or solid, as desired. Eleven different sizes of spaces were used in justifying. Meanwhile distribution proceeded undisturbed. Three columns of dead matter could be placed on the distributing table beneath the machine at one time, with leads and rules extracted. A line at a time was forwarded to a testing mechanism, where all defective type was discharged. A selecting mechanism next removed any type turned or inverted, as well as

all irregular characters, such as accents, reference marks, etc. The remaining types were advanced to their proper channels in the composing section of the machine, the spaces going to the justifying section. Distribution and composition proceeded simultaneously without interference, specially nicked type being used to accomplish distribution, the type entering the channels at the bottom and being pushed upward, the assembling types leaving the channels about two inches above. The distributor would handle the type wet or dry, clean or dirty, the distribution being stopped when any channel was full. Finally the machine measured the type set and a dial indicated the amount. Automatic stops locked every working part of the machine whenever its mechanism became deranged. Every movement was a positive mechanical one, there being no carrier belts or gravity devices. The model machines constructed were built for handling but one size of type, though the machine could easily have been made interchangeable. The Paige Compositor, nine feet long and weighing over three tons, was run by a quarter-inch round belt and required but one-twelfth horse-power.

THORNE AND SIMPLEX.

In 1880 Joseph Thorne, who had since 1869 been experimenting with typesetting machines of the usual pattern, adopted the cylindrical form of composing machine, and met the greatest success so far achieved with typesetting machines. The Thorne machine was a combined distributor and setter, its

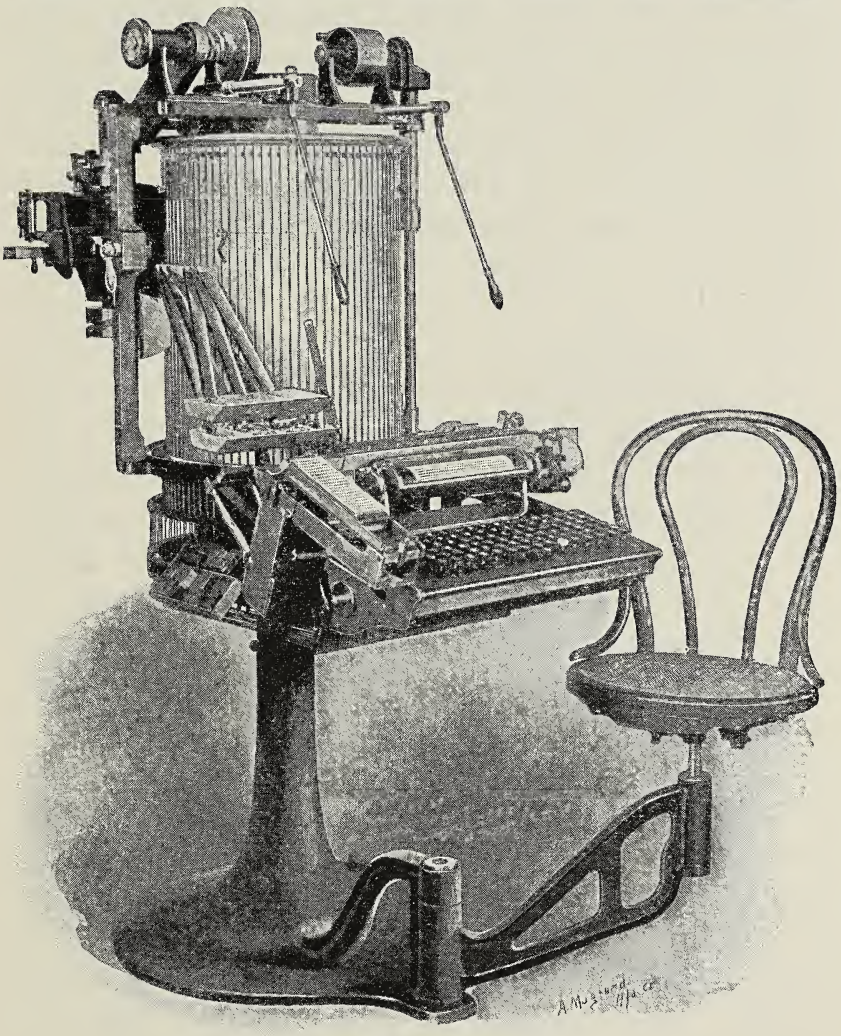
compactness being a strong point in its favor. It employed two type cylinders about fifteen inches in diameter, of ninety channels each, one surmounting



THE THORNE.

the other, the upper one rotating and feeding the type into the lower channels, from which a steel plunger, operated by a keyboard, ejected the bottom type on to a swiftly revolving disk, which whirled

it into a raceway and assembled it in a continuous line. The upper cylinder was loaded by inserting lines of the type, which was specially



THE SIMPLEX.

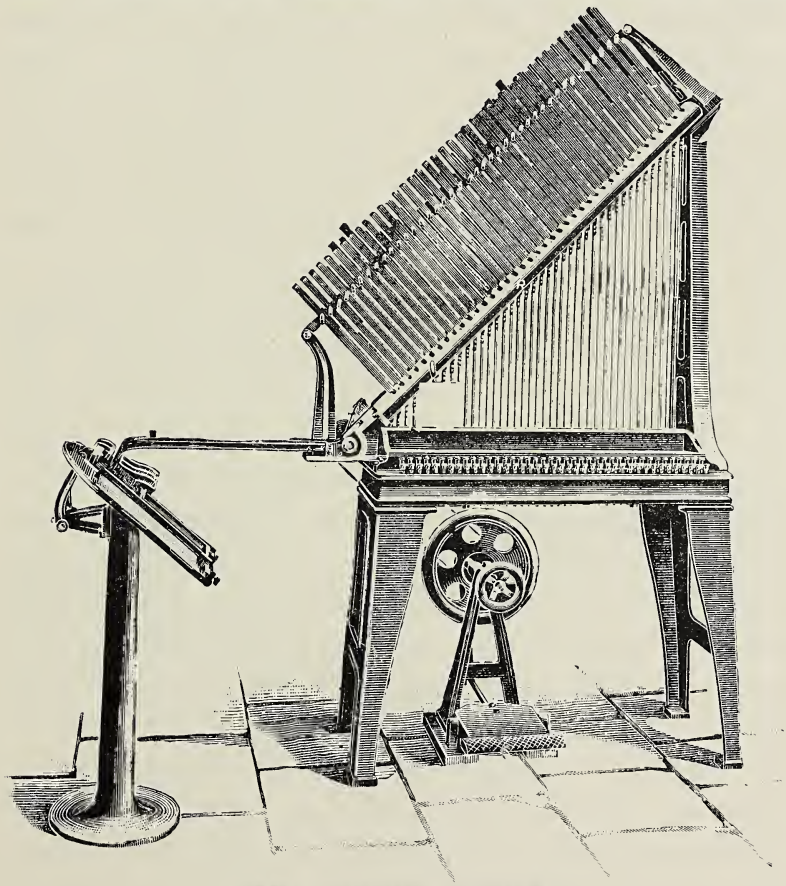
nicked, into the channels, the cylinder revolving and allowing the type to enter its proper channels in the lower magazine cylinder. As each channel in the

lower cylinder had at its entrance a combination of wards or lips which matched only the nicks in the appropriate type, only that particular letter could drop into the lower channel when both upper and lower channels were brought into register by the step-by-step rotation of the upper portion. The Thorne machine went into use in a large number of printing-offices. In 1898 the company was succeeded by the Unitype Company and the entire machine remodeled and brought out as the Simplex One-Man Typesetter. The Simplex is equipped with an automatic loading mechanism which inserts the lines of dead type in the distributing cylinder as fast as the channels are depleted, improved mechanisms are incorporated to insure distribution without fouling, and the justifying arrangements improved so that the operator, after assembling the type, can swing over and perform the justification instead of employing a second person, as in the Thorne. Quads and spaces are distributed directly to receptacles convenient to the hand of the justifier, and the matter can be leaded automatically if desired. The keys of the Simplex can be operated simultaneously in any combinations running from left to right without danger of transpositions. The output is from three to four thousand ems per hour, with one operator, while with one operating and another person justifying 9,000 ems per hour have been set. Machines are designed for only one size of type, occupy eight square feet of floor space and weigh less than eight hundred pounds. The Simplex requires about one-fourth horse-power and costs,

complete, $1,500. Over five hundred Simplex machines are in operation in the United States alone.

WICKS COMPOSING MACHINE.

Frederick Wicks, of Glasgow, Scotland, inventor of the Wicks Rotary Typecaster, also invented a type-setting machine in 1883. A unique feature of the Wicks composing machine was the fact that not a single spring was used in its construction. The type was contained in upright inclined channels and



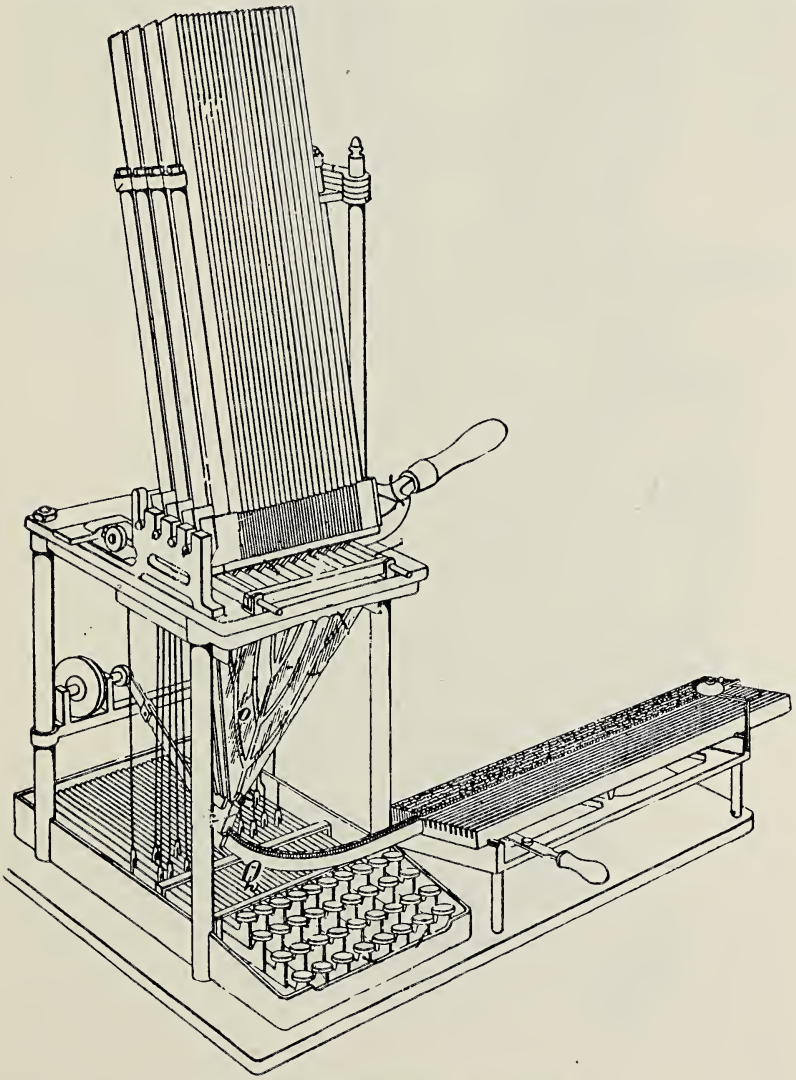
WICKS COMPOSING MACHINE.

released by the usual keyboard arrangement. The operator supplied the power for assembling by working a treadle. Soft metal spaces were used, either hollow or having enlarged portions capable of being crushed by compression applied to the ends of the lines to effect justification.

McMILLAN SETTER AND DISTRIBUTOR.

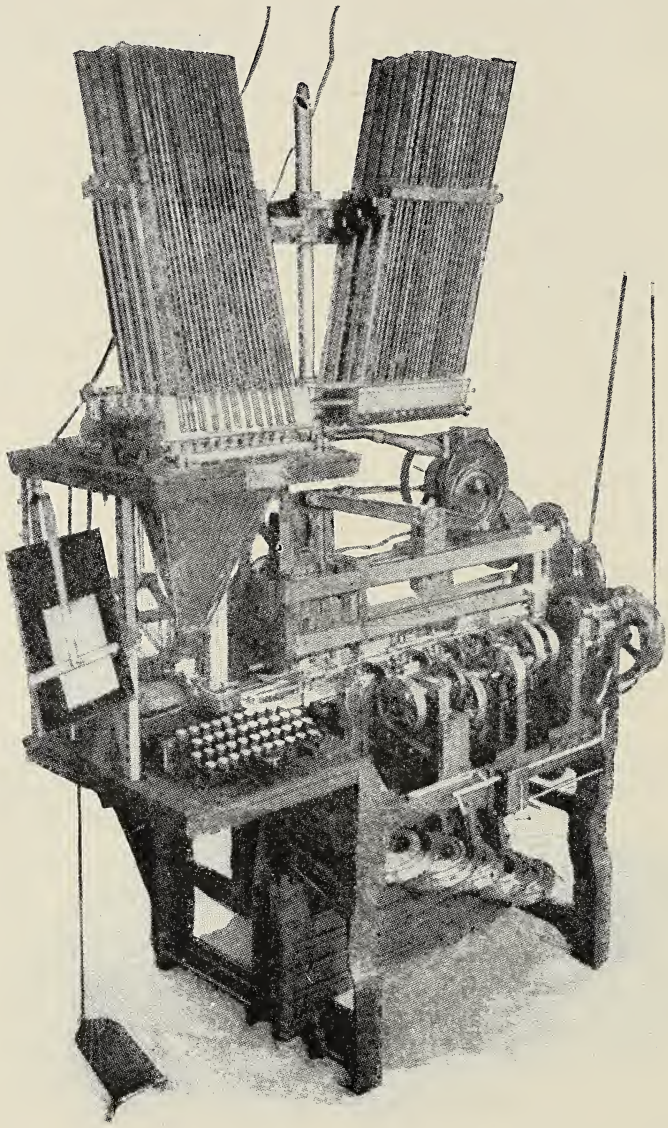
John L. McMillan, of Ilion, New York, was the inventor of a typesetting machine which was used extensively until the advent of modern mechanisms. In 1884 McMillan began the construction of a series of machines, producing several types of setting and justifying devices. In one of these composing machines the type was assembled on storage galleys, about two feet long, which held from twenty to forty long unjustified lines, the galleys being proved in this condition and read and corrected before being justified by a separate justifying machine. His composing machine of 1890 contained a series of type channels, each one removable, in four rows. In the "double-header" machine, adapted to handling two sizes of type, an extra set of type channels was swung so that it could be brought into use with little delay. The keyboard contained forty-eight keys, and was made to control eighty-four characters by means of shift keys. When a key was struck the lowest type in the channel was removed, not by pushing, but by means of a grab, which seized the type by the nicks and pulled it from the channel, allowing it to drop by gravity to the central point in front of the keyboard. When a line was completed

a special key was struck and the line pushed into the raceway toward the justifying mechanism, which he combined with his composing machine in 1894. Here one of five carriers seized the line, which as originally set, was spaced with the comparatively thin



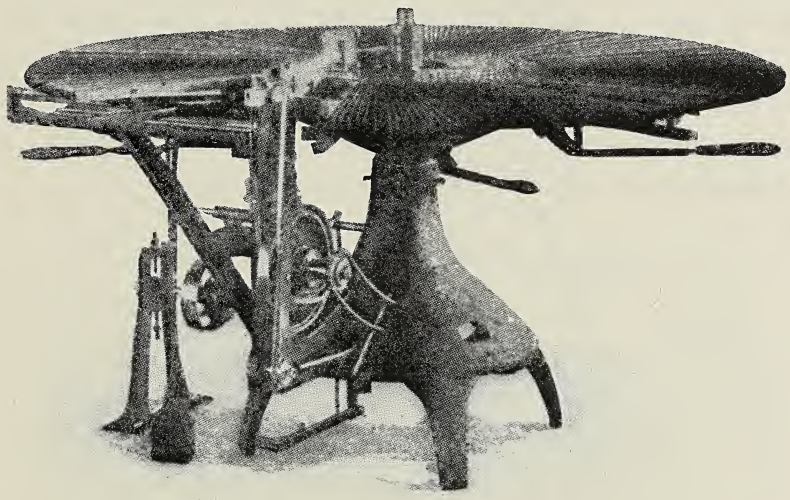
MC MILLAN COMPOSING MACHINE.

spaces. The carrier moved the line to the right, in the pathway of a series of feelers. These feelers had projections that fell into appropriate nicks



MC MILLAN COMBINED SETTER AND JUSTIFIER.

in the spaces, and whenever a feeler fell into the nick of a space it made an electrical connection, which set in motion a mechanism which thrust out that space and pushed in its place a space of the next larger size. Five sizes of spaces were employed, and the process of changing the spaces to the next larger size went on until the line filled up the space in the carrier, after which the feelers refused to act and the justification was



MC MILLAN DISTRIBUTOR.

complete. The line was then pushed out on a galley. The several sizes of spaces were arranged in spiral channels and the spaces discarded in justifying were worked back to their original positions. The matter could be set leaded or solid by setting a gauge to supply the leads for any desired number of lines, after which it would be automatically thrown off. Both setter and distributor were run by belted

power. The New York "Sun" had a battery of three McMillan machines for several years, and they were used in a number of other offices.

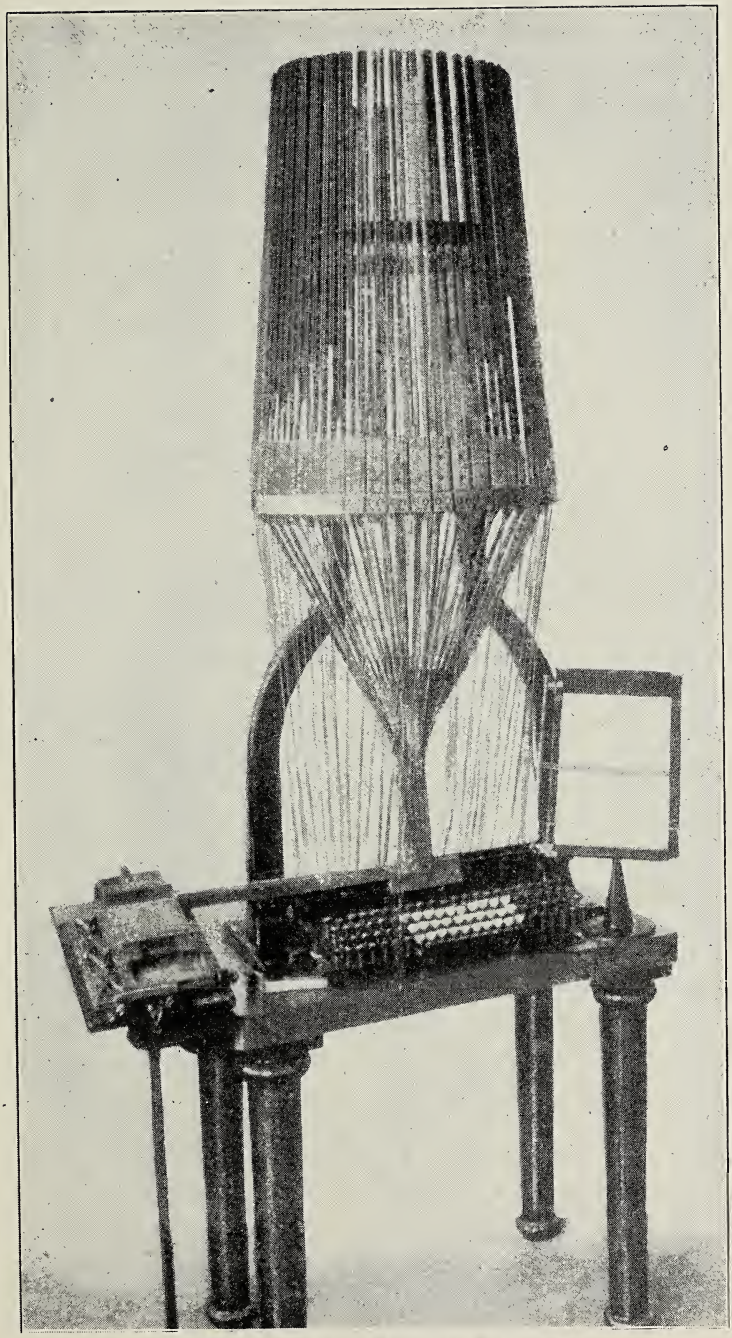
A separate distributor was required with the McMillan. It consisted of a circular frame supporting hundreds of movable type channels, radiating from the center. The type to be distributed was placed on a galley beneath the machine and a blade raised a line at a time and thrust it at regular intervals into the central rotating disk which, by means of wards and special combinations of nicks in the type, distributed the letters to their appropriate channels, which when full were removed and placed in the composing machine. The distributor was capable of disposing of fifteen thousand ems an hour.

LORENZO DOW'S MACHINE.

Lorenzo Dow, of Boston, Massachusetts, was another one of those to adopt the cylindrical form of typesetting machine, he bringing out his machine in 1885. The father's inventive genius descended to his son, Alexander Dow, who in later years produced a more perfect form of an individual typesetting machine.

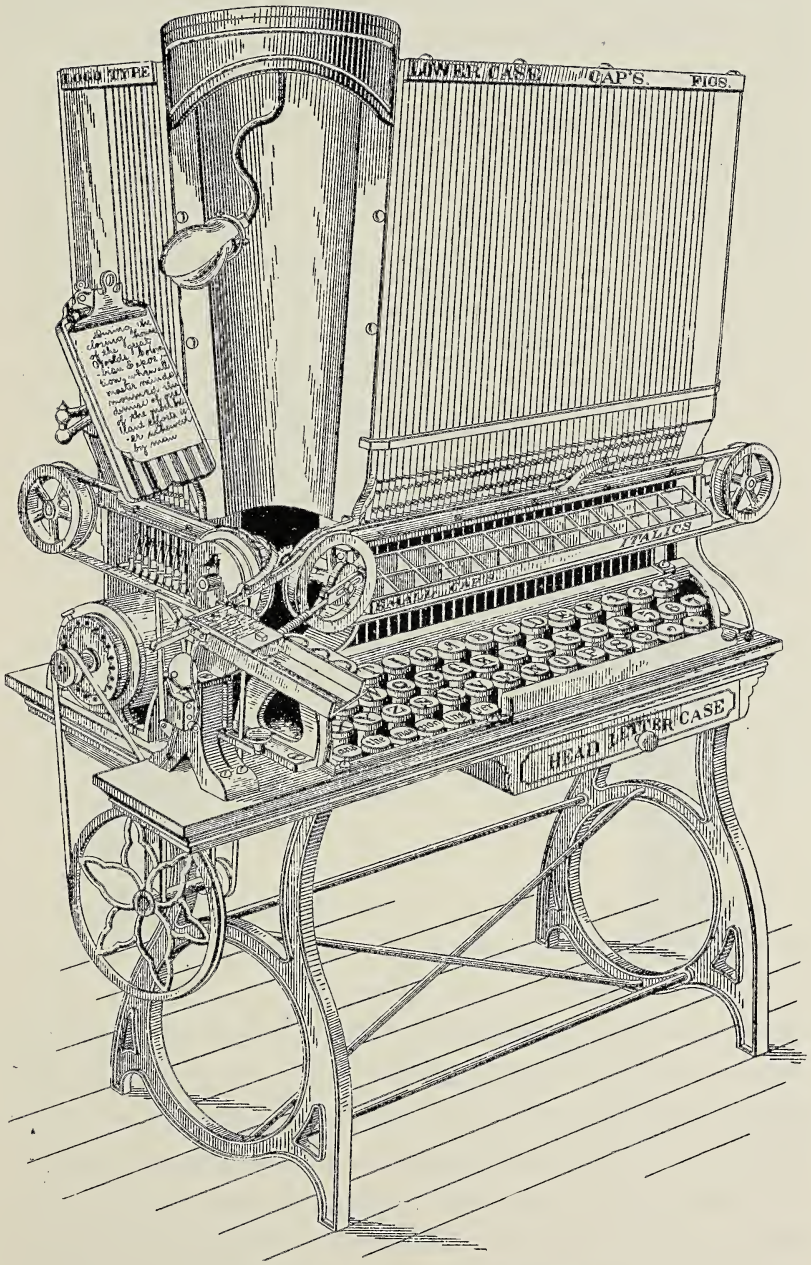
COX SETTING AND DISTRIBUTING MACHINES.

A new model of type-composing machine was introduced by Paul F. Cox, of Battle Creek, Michigan, in 1894. In this machine, logotypes and single types were contained in channels and carried by belts to the assembler, and justified into lines by hand. The logotype channels were at right angles



LORENZO DOW'S COMPOSING MACHINE.

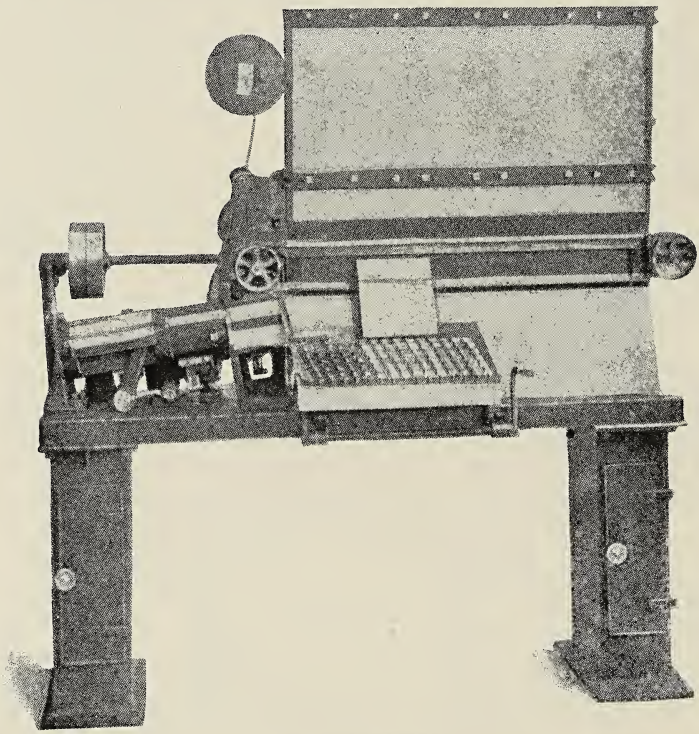
with the type channels, but the type was assembled at a common point. In 1894 Cox devised another novel composing machine, in this apparatus using corrugated spaces to accomplish justification of the composed lines of type. Three separate machines were required with the Cox method, a composer, a space and lead discarder, and a distributor. The composing machine had a number of vertical type containing channels, placed at an angle, so that the type was ejected by the operation of the keyboard on to a carrier belt, which conveyed the letters to the assembling point. Above the assembler a reel of soft metal ribbon was mounted, the operation of the space key causing a section of this ribbon to be unwound, cut off, crimped, and dropped into the line between the words as composition proceeded. It was also proposed to use previously cast crimped spaces in this machine. The line was overset, and when complete a lever to the right of the keyboard was depressed, throwing the machine into action. A small cylinder containing a number of slots, in one of which the line was assembled, now revolved, side pressure was applied and the line brought to the proper length by compressing the crimped spaces, another slot in the cylinder meanwhile being presented to the assembler for the reception of another composed line, the next partial revolution of the cylinder bringing the justified line to the galley, where the line was ejected, leaded or solid, as desired. One size of type only could be composed on the Cox machine, the range of justification being from a thin space to about an em quad in thickness. Any length



COX'S FIRST COMPOSING MACHINE.

of line from 13 to 26 ems could be composed. A speed of four thousand ems per hour was claimed for the composing machine.

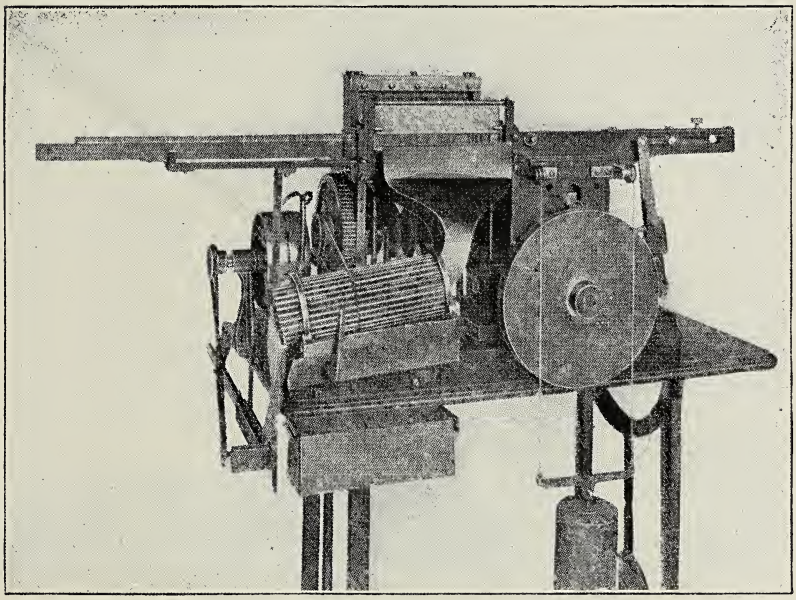
Before being placed in the distributing machine, type set on the Cox machine was run through a lead and space discarding apparatus. This machine sepa-



COX TYPESETTER.

rated the type line by line and removed the leads if any. The line was then fed along to the quad and space discarder, feelers inserting themselves over the tops of quads and spaces, and forcing them down and out of the line, which then passed into a long channel, from whence it was taken and placed in the distributing machine. The discarded quads were

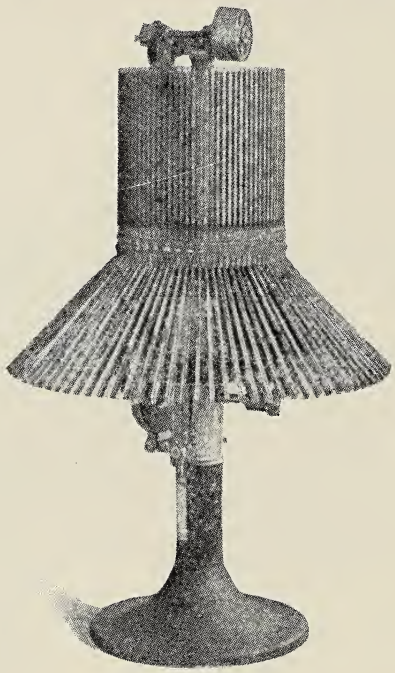
separated from the crimped spaces and assembled in a channel ready for the composing machine. One discarder was capable of handling dead matter for three distributing machines, its speed being thirty thousand ems per hour.



COX SPACE AND LEAD DISCARDER.

The distributing machine was a combination of Thorne and McMillan distributors. Channels of type from the discarding machine were placed on end in upright channels of the cylindrical distributor. The type was specially nicked, and as the cylinder revolved the type was distributed into type channels which radiated from the lower end of the cylinder, which channels were then removed and placed in the composing machine. Duplicate channels for the letters most used enabled distribution to be done

rapidly. One distributor was sufficient to supply two or more composing machines. Several Cox machines were placed in use, but upon the absorp-



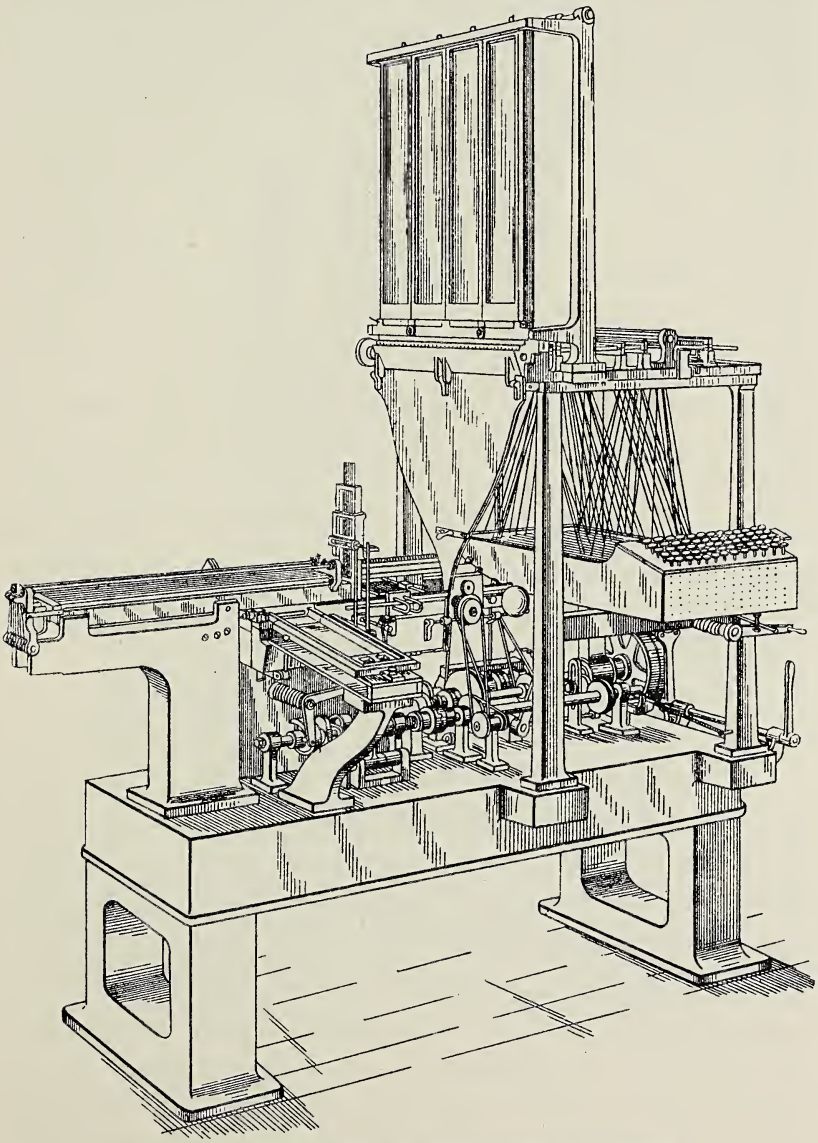
COX DISTRIBUTOR.

tion of the Cox patents by the Unitype Company they were withdrawn. An attempt was made to embody the Cox method of justification in the Simplex machine, but without success.

THE CONVERSE MACHINE.

Frank B. Converse, Jr., of Louisville, Kentucky, in 1894 invented a typesetting and automatic justifying machine, using foundry type. There were four groups of type channels in the Converse, with twenty-three channels in each group. Duplicate

channels for the letters most used were provided, there being three channels of e, two of a, o, n, etc., the operation of a shift key when a certain channel



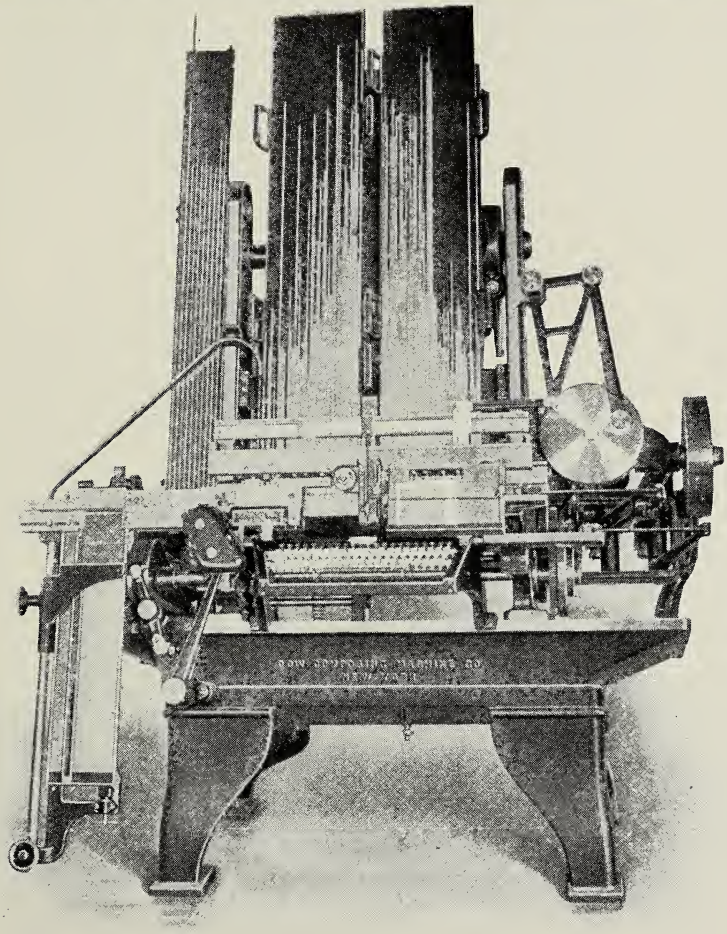
CONVERSE TYPESETTING AND JUSTIFYING MACHINE.

was empty causing a full channel to be substituted for an empty one, and when the type was exhausted the operation of the keys was automatically stopped, giving notice that the supply must be replenished. This was done by removing the empty channels and substituting full ones. The action of the keyboard was rendered light by causing the operation of the keys to throw the ejecting mechanism into engagement with a source of power. Mr. Converse employed as a justifying device an arrangement almost identical with that used by Frank McClintock in the Empire justifier. Temporary steel wedges were inserted between the words in the line, these wedges, when driven through the line to justify it, determining the selection of the proper size of spaces, which were then automatically inserted and the wedges withdrawn. Litigation over the priority of this invention and the failure to provide a satisfactory distributor prevented the progress of the Converse machine.

DOW COMPOSING MACHINE.

A one-man typesetting and justifying machine was invented in 1896 by Alexander Dow, of New York city. The Dow composing machine occupies seventeen square feet of floor space, is over six feet high, and weighs about a ton. The type magazine is divided into two parts for greater convenience in handling when changing from one face to another. The machine is capable of composing all sizes of type from 5 to 12 point. The type channels are four feet in length and afford a large capacity for type, which

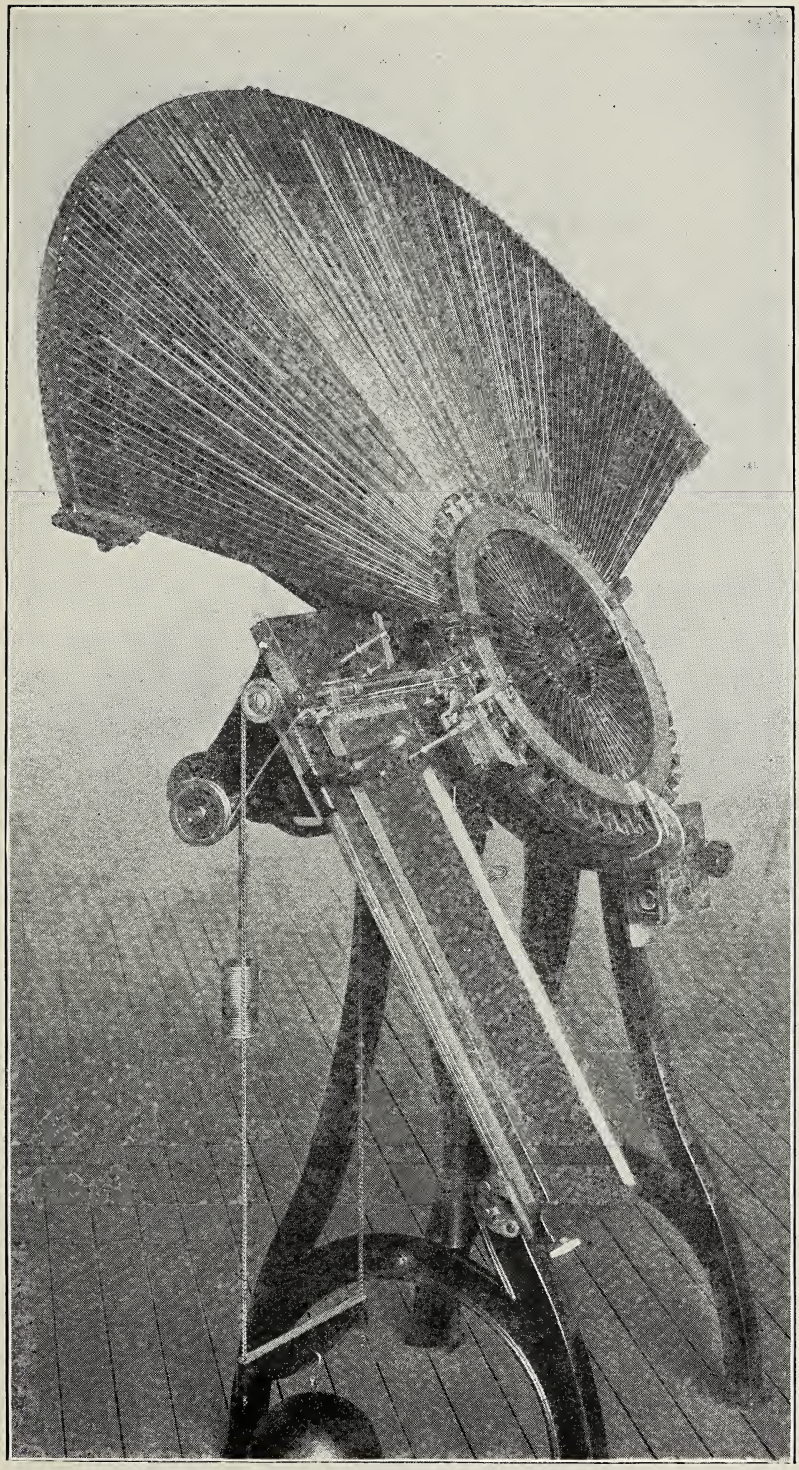
is further increased by duplication of channels most used. The type is released by positive actions, the touch of the keys merely serving to set in motion certain releasing mechanisms. An average of twelve thousand ems per hour is possible on the keyboard. The types are ejected into a raceway. Rapidly reciprocating type-drivers traversing this raceway push



DOW COMPOSING AND JUSTIFYING MACHINE.

the ejected type to a central channel, where another blade pushes them down into the assembling stick. As the type is assembled, temporary brass spaces are brought into place between the words. When the line is complete the depression of a line-key causes the stick to make a half turn and the type is ejected on to a raceway, where the line is automatically measured and the exact amount it lacks of complete justification is registered by the calculating device. This shortage is thereupon divided by the number of times the space key was struck by the operator in setting the line, the quotient being the proper thickness of spaces which, when inserted between the words, will accurately justify the line. The line is then separated word by word, the temporary brass spaces being removed and returned to the magazine and the proper justifying spaces brought from the space magazine and deposited between the words as the line is advanced to the galley, where it is delivered, leaded or solid, as desired. This justifying apparatus is really the most ingenious part of the Dow machine. If the calculation shows that no even division of the ten available spaces will exactly justify the line, the mechanism will select any combination of these spaces that will do so and place them between the words.

The distributing machine used in connection with the Dow was somewhat similar to the McMillan distributor. A central rotating disk supported on its periphery thirty-six type carriers. As these carriers revolved step by step past the type galley, each carrier received a single type, which was deposited

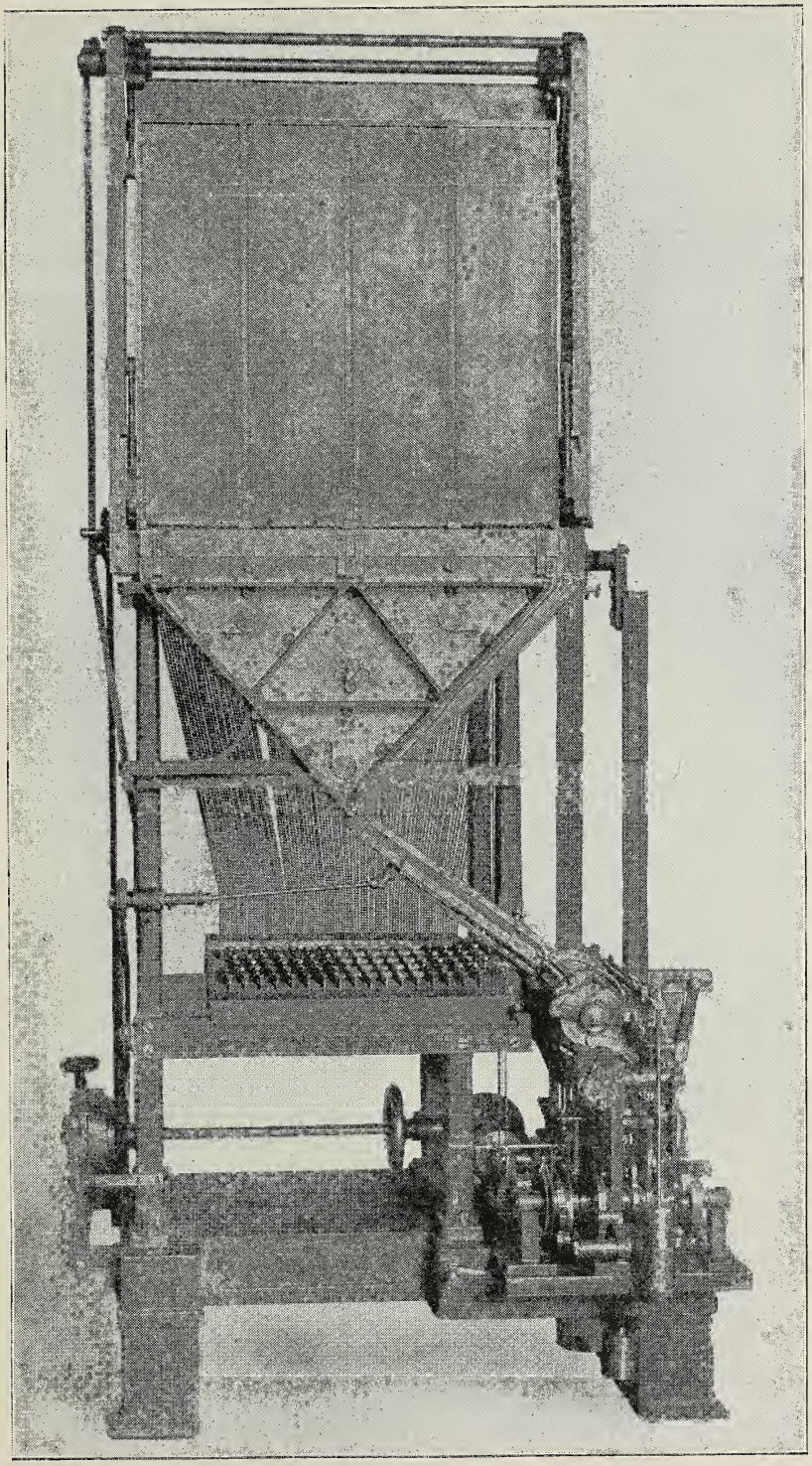


DOW DISTRIBUTOR.

in its proper channel as the carrier arrived opposite it in its revolution, the wards at the entrance of the channel and the special combination of nicks in the type permitting this distribution. When any channel was full it was removed and placed on storage racks, ready for the composing machine. It had a capacity of from twelve to fifteen thousand ems per hour, and was entirely automatic in its action. In the distributing machine now employed the type channels are not inclined and many improvements are embodied.

NEW CONVERSE TYPESETTING MACHINE.

An entirely new mechanism for composing and justifying individual type was patented by Frank B. Converse, Jr., in 1902. This machine occupies a floor space of about 21 by 36 inches, is about seven feet high over all, weighs about one thousand pounds and requires for its operation about one-eighth of a horse-power. It is provided with ninety finger keys which are operated to release the type. The types fall by gravity through the channels of a race plate to a point where they are delivered to mechanism which carries them to the assembling point and delivers them into the stick. When the stick is full, the operator presses a line-key, which moves a new stick into place and sets in operation automatic mechanism by which the assembled line is correctly justified; then the justified line is delivered with or without leads into the galley ready to be printed from. As the type is assembled, temporary spaces are inserted in the line. The justifying



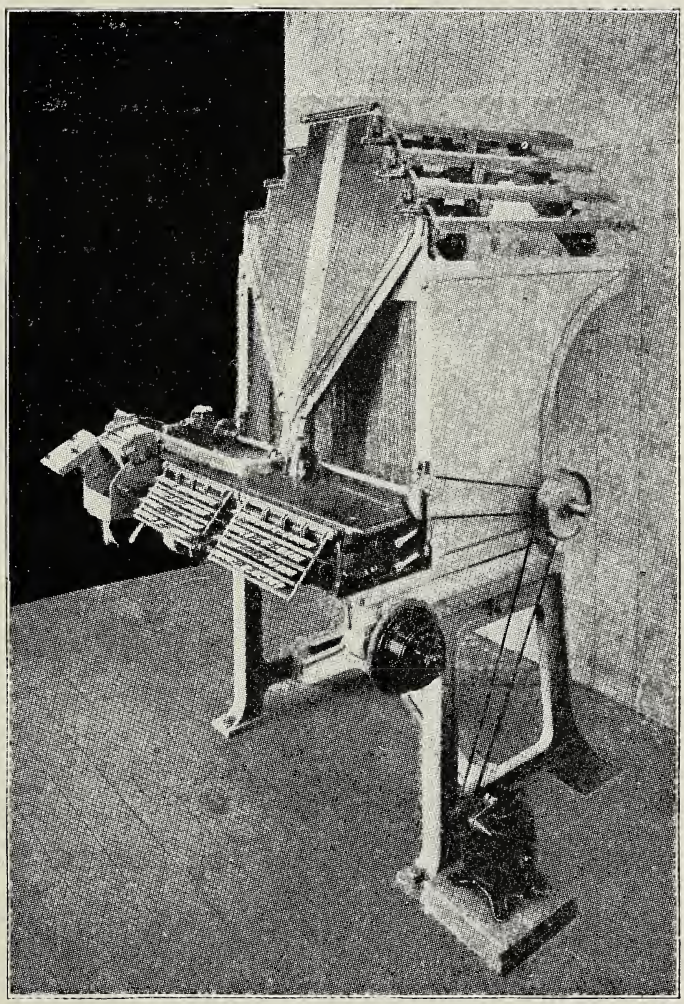
NEW CONVERSE COMPOSING AND JUSTIFYING MACHINE.

mechanism makes the necessary measurement of the assembled line, determines the shortage, and then for the temporary spaces substitutes spaces which are of the proper width to effect justification. Only two widths of spaces are used in any line, and they differ in width only one-hundredth of an inch. The justifying mechanism may be adjusted to justify any length of line up to four and one-half inches. Roman and italic fonts can be set at the same time and in the same line; or, if italic fonts be not wanted, then roman and head-letter, without increasing the number of keys. The shift from roman to italic is accomplished by a movement of a hand lever at the left of the operator. The reverse of that movement changes back again from italic to roman. To permit this, each machine has two sets of cases, one for roman and one for italic letters, and these cases stand vertically, one behind the other. The moving of the shifting lever lifts one set of cases from and sets the other into co-operative relation with the type ejectors. The machine is adapted to assemble seven different bodies of type, from pica to agate. To adapt the machine to a different body of type it is necessary to replace the cases with cases containing the different types to be assembled, and to adjust the race plate channels. This adjustment is accomplished by the turning of three screws into positions indicated by graduation marks.

THE PULSOMETER MACHINE.

The latest individual typesetting machine is that of the Pulsometer Engineering Company, of Reading,

near London, England. It was first shown at the exhibition at Agricultural Hall, London, in 1904. The principal difference between this apparatus and other machines of this class lies in the arrangement of the type reservoirs, which are placed horizontally instead of vertically, the type being pushed forward

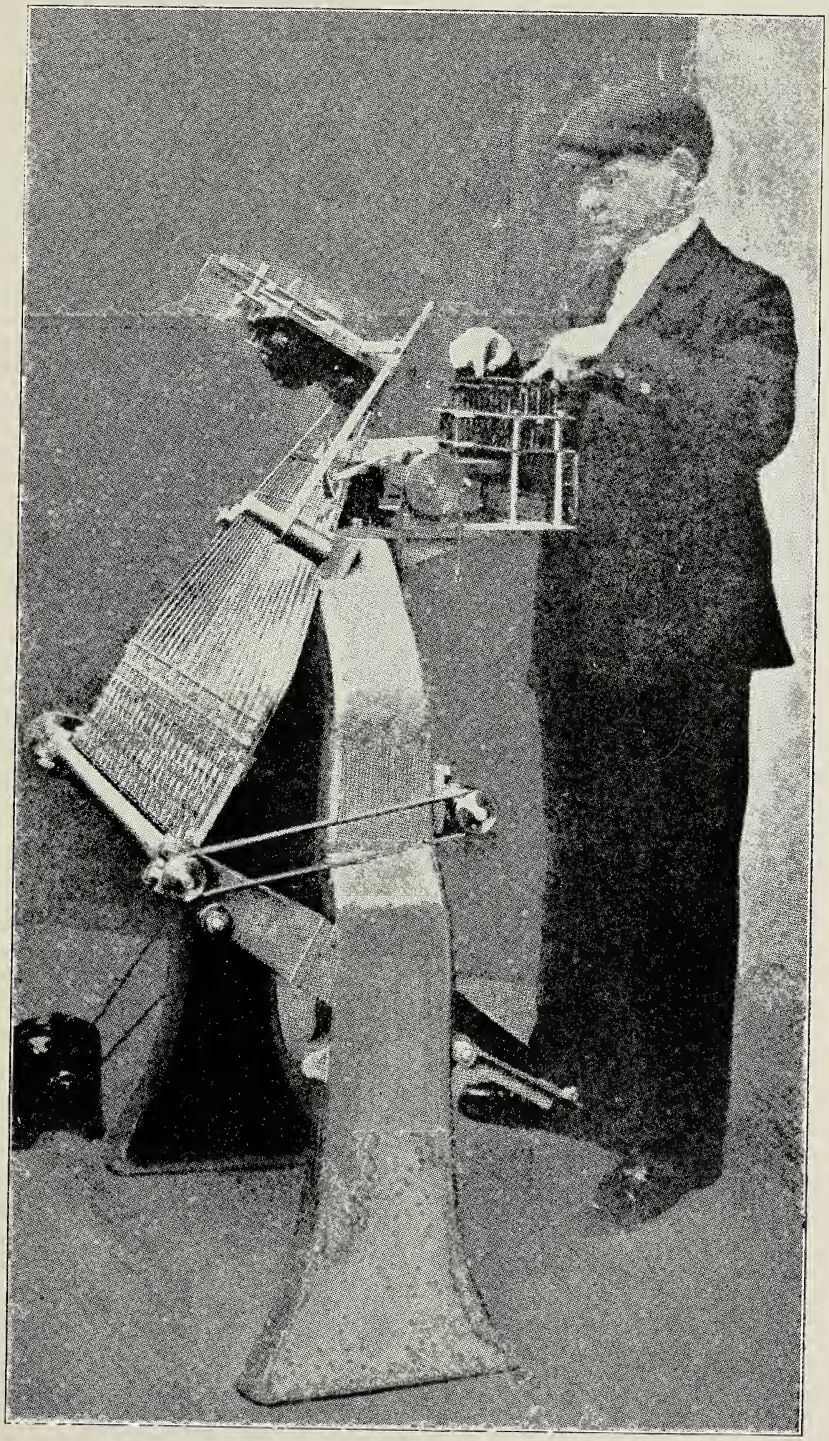


PULSOMETER COMPOSING MACHINE.

to the outlet by weighted followers. The reservoirs or channels are arranged in vertical steps rising toward the center of the machine. There are 116 channels in all, which allow for upper and lower case, small caps., figures and the usual extras. Each channel has its corresponding groove in the front plate, which inclines slightly outward and is covered with glass. The type is released from the channels by ejectors, which, pushing from the bottom, raise the letters above the lips which hold them and they thereupon drop into the converging channels in the face plate and assemble in a curved trough in front of the operator. A rapidly revolving eccentric pushes the type forward as it drops feet first into the line, this eccentric and the ejecting mechanism being driven by a small motor.

The line is assembled in the composing trough and passes thence to one of several channels or grooves in a cylindrical receiver. The operator receives warning by a bell when one of the grooves has received enough matter to make a line, and by touching a key causes a partial revolution of the cylindrical receiver and an empty groove to be presented. In the present machine about seven hundred and fifty ems can be composed before stopping composition, the operator then swinging around and justifying the matter by hand as usual. The price is fixed at $750.

The type is distributed in a separate machine, supplied with a keyboard. The dead matter is raised from the galley and the operator reads the words as they pass before him and touches the keys as in



PULSOMETER DISTRIBUTING MACHINE.

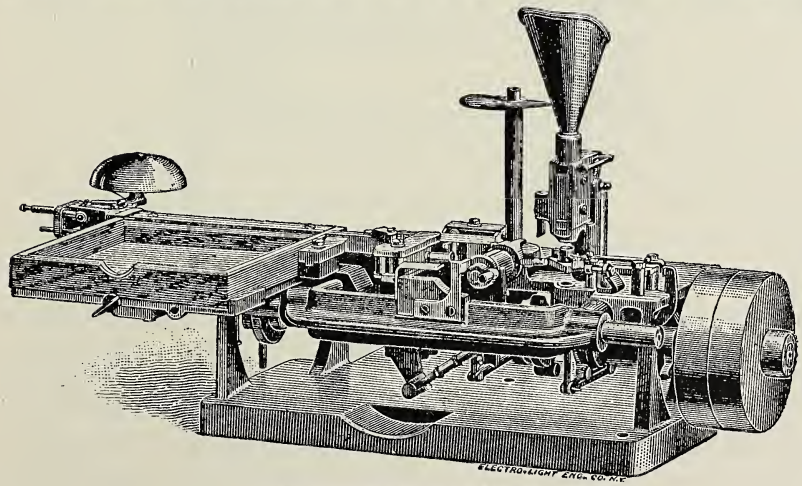
the composing machine. No nicks are employed to accomplish distribution, but instead, the type is separated according to its width. The first separation of the type divides it into grups of four letters varying at least .008 of an inch in thickness, these next passing through three bridges, the first allowing only the thinnest three type to pass, the next the thinnest two, and the last only the thinnest one of the group to enter, thus distributing each letter to its proper channel. Any full channel can be removed and its contents discharged into the corresponding channel of the composing machine without disturbing any other channel. The price of this distributing machine is $750.

Hand Apparatus

Inventors for many years have striven to produce a machine to facilitate hand composition without the aid of keyboard manipulation, thus reducing to a minimum the attendant mechanical appliances. None of these machines has survived, and but one reached the marketable stage.

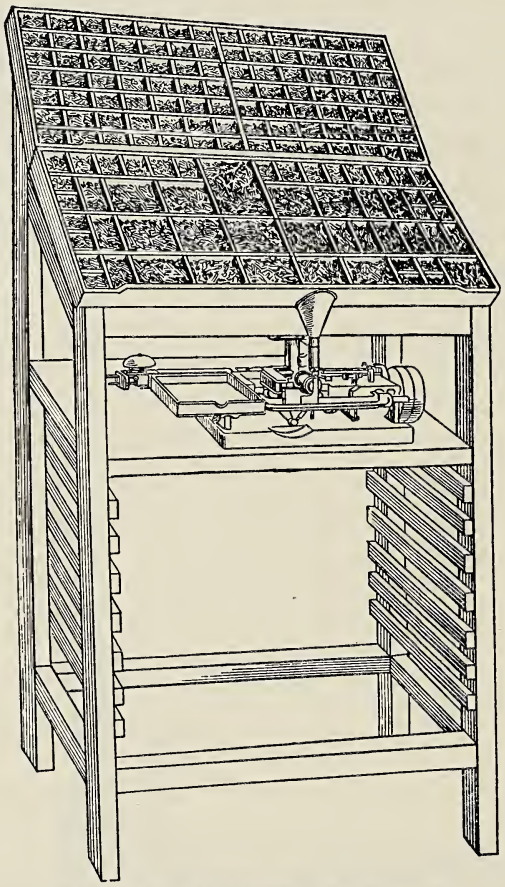
THE LAGERMAN TYPOTHETER.

Harger, Brown, and others early in the sixties worked on machines which attempted to keep the type so arranged as to permit rapid composition by hand. Alexander Lagerman, of Sweden, however, was the first successful inventor of a machine on this order, and his machine, the Typotheter, first brought



THE CHADWICK TYPESETTER.

out in 1887, underwent many changes, and was afterward presented as the "Universal," and later as the "Chadwick." The Lagerman machine was based on the proposition, later proven erroneous, that a type-



CHADWICK TYPESETTER IN POSITION.

setter could pick up type faster with both hands than with one, as was the time-honored custom. Working on this line, Lagerman provided a small mechanism which could be placed on a board beneath the ordinary type case, the compositor picking the type from

the case with both hands and dropping it into a funnel provided on the machine. A small motor caused a series of feelers to turn the type, face up, nick out, no matter how it was dropped into the hopper, and forwarded it through a raceway to the galley. The stroke of a gong warned the compositor when the line was full, and it was thereupon shifted into a channel in the receiving galley in its unjustified condition, and the next line composed and deposited in another channel, until the matter was entirely composed.

THE CHADWICK.

In the Chadwick machine it was proposed that the compositor on completing a line throw into the hopper the proper number of spaces to justify the line, this being indicated to him by a dial, and after the "take" was completed, transpose the spaces to their proper position between the words. Although the Chadwick was offered for $300, it failed of commercial success, the saving over hand work being trifling.

INVENTIONS OF JOHNSON AND LOW.

L. K. Johnson and A. A. Low have a unique record in patents on typesetting machines. Beginning in 1880, they, in collaboration with one or two others, have taken out a larger list of patents than any other group of inventors, and have not yet produced a complete device. Their patents are assigned to the Alden Type Machine Company, the apparatus being seemingly designed to assist in composing type by hand.

Automatic Justifiers

Although divers methods of accomplishing the automatic justification of individual type have been proposed, the fact remains that there is not on the market to-day a practical automatic justifier. Some of the methods proposed are spring and rubber spaces; corrugated or hollow spaces to be afterward crushed to proper size; selection of proper spaces by calculating devices after measurement of the line; cutting spaces from space timber after measurement or casting of the spaces based on measurement of line or calculation of its constituent units; progressive substitution of spaces until justification is secured; the use of wedges to operate the space-selecting mechanism, or type metal wedges driven through the line and the surplus broken or cut off; the method of inserting thin spaces until the line is justified or oversetting and subtracting them until the same result is achieved; and finally the latest proposition, to use em spaces and cut them down to the size desired after oversetting and measuring the line.

SPRING SPACES.

It is presumable that, from the earliest times, printers have been guilty of assisting the justification of type by bending the spaces, but it remained for E. C. Harmon, of Troy, Ohio, to patent, in 1852, the

idea of using a "cyma recta or other more suitable shaped elastic space for facilitating the art of setting type or for saving the time and labor usually expended in spacing out, thin spacing, regulating the distance of words in the same line from one another and correcting proof." He proposed to employ S-shaped spring spaces between the words, but the impracticability of handling type so spaced prevented its adoption.

D. B. Dorsey and E. Mathers also patented in 1860 spring spaces, theirs being shaped like the letters N, V or W.

Charles F. Hilder, of London, England, as late as 1896 patented a spring space, his being two thin plates of steel, oppositely bent. Like his predecessors, he neglected to consider the "make-up" man.

PROGRESSIVE INSERTION OF THIN SPACES.

The earliest inventor of an automatic justifier was Charles W. Felt, of Salem, Massachusetts, who, in 1863, patented a machine in which the lines were assembled with a temporary space between the words, and if short of complete justification, a thin space was automatically inserted between each word, the line being gone over again and again until justified, when the temporary spaces were withdrawn and regular spaces took their place. Two thicknesses of spaces were used, the thinner size being brought into use when occasion demanded. Such an apparatus would justify lines almost as fast as the hand compositor.

A plan of justification invented by C. H. Cochrane in 1900 had for its novelty the employment of a pointed spreading tool adapted to be inserted between the words and reciprocated in and out of the line, each time depositing thin spaces until the line was completely justified.

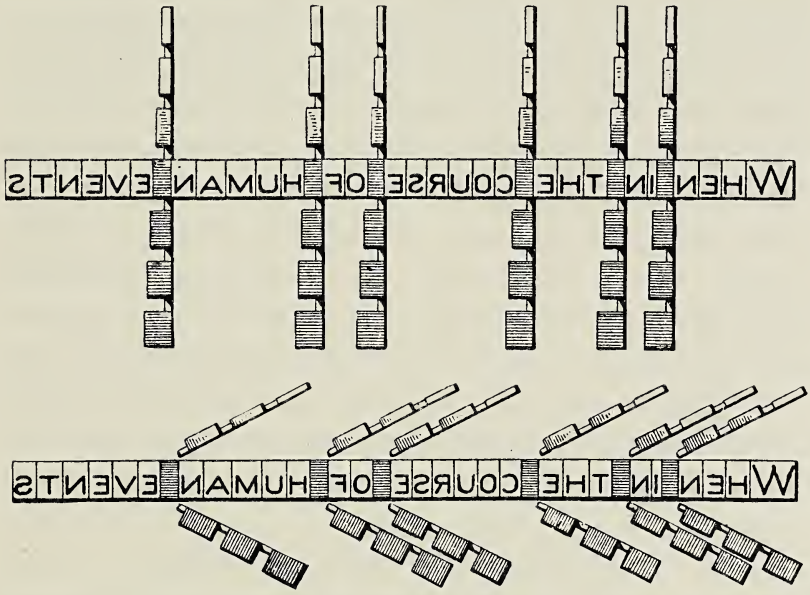
CORRUGATED SPACES.

Alexander Mackie is to be credited with conceiving, in England, in 1868, the idea of using corrugated or grooved metal spaces, oversetting the line, and afterward applying pressure to bring it to the proper measure. Ten years later, Frederick Wicks, of Glasgow, Scotland, incorporated a similar idea in a typesetting machine, the next inventor to employ the crimped space being Paul F. Cox, who incorporated it in his machine of 1894. A modern adaptation of this idea is found in the typesetting machine of J. C. Fowler and son, who employ soft metal blanks between the words, overset the line, and, after crushing the spaces to the proper width to justify the line, pass the complete line between a pair of knives to remove any protruding metal from the spaces.

JUSTIFICATION BY WEDGES.

In 1874 D. B. Ray, of Galena, Illinois, proposed to justify lines of type by means of double spaces which were beveled on their opposing faces and were pressed down to justify the lines with a wedging action. The objection to this method was the abnormally wide spacing produced.

Paul F. Cox, in 1898, invented what he called a "multi-space." It was a graduated wedge of type metal, the thick edge being inserted between the words and the line overset and the spaces retracted



COX'S MULTISPACE.

until the line filled the measure exactly. The portions of the spaces projecting above and below the type were then broken off and discarded. P. H. McGrath, in 1899, proposed to justify the lines in a similar manner, but using solid wedges of metal and sawing off the excess after the wedges had been advanced to spread the line.

SELECTION BY PERFORATIONS.

Automatic justification of the type set by machinery controlled by a perforated strip or ribbon was

invented by James E. Munson, of New York, in 1882. His plan was to separate the perforations from each other by distances proportioned to the thickness of the characters represented, and, after the proofreader had noted the corrections necessary and the operator had made such corrections in the tape by eliminating or making additional perforations, a scale was used to determine what size of spaces would justify the line, the operator then perforating the tape between the words with the proper signs. This corrected ribbon was then used as copy to prepare a perfect ribbon which, when fed through the composing apparatus, controlled the selection of the proper type and justifying spaces. In this apparatus feelers dropped into the holes in the tape as it was unreeled and established electrical connections which caused the ejection and assembling of justified lines of type.

CALCULATING MECHANISMS.

B. M. Des Jardines brought out his automatic justifier in 1887. In this machine the line is assembled with brass separators between the words. Each time the space key is struck it is recorded, and the line when completed is measured and a computing device calculates the proper combination of spaces necessary to do the justifying. The line is then moved forward, and the first word pushed down into a movable channel, the brass separator preventing more than the first word entering. This word is then run backward to the space channels, and a type space of proper size is released and pressed downward and takes the place of the temporary

separator. The word and space are now advanced and the second word pressed down, both moving backward to receive the next space, and this is continued until the whole line has received the proper justifying spaces.

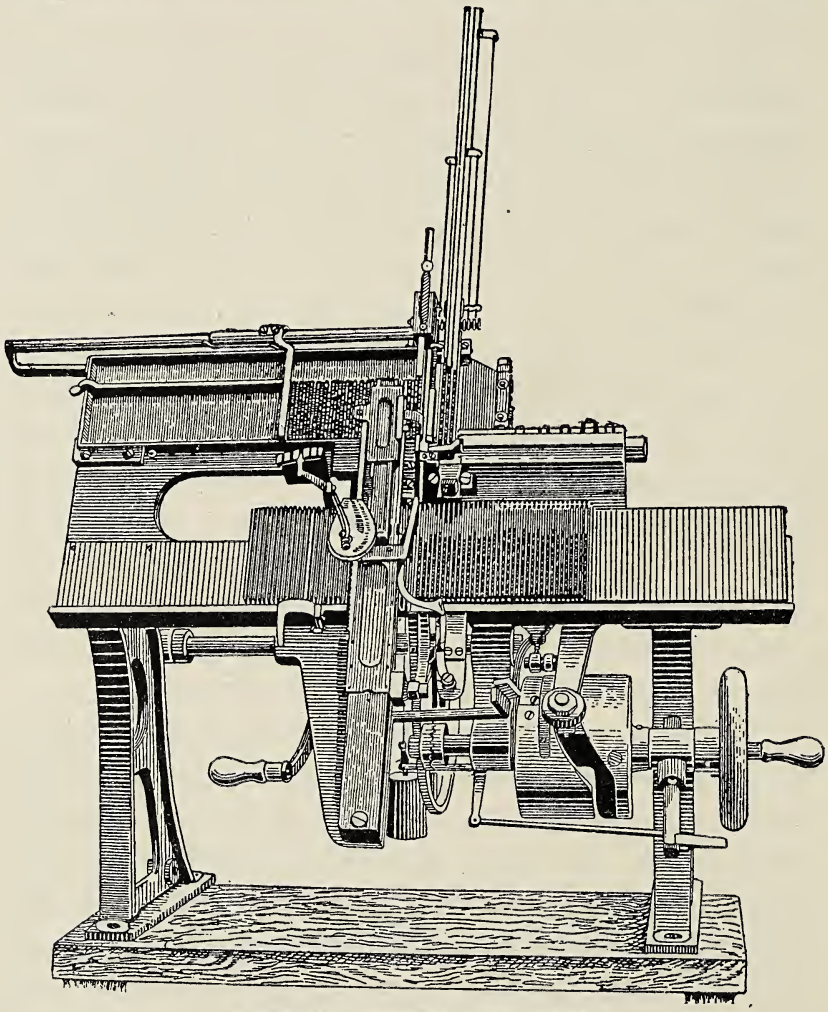
The justification scheme employed in the Paige Compositor of 1893 was based on the measurements taken of each word as composed, the recording of these measurements by a mechanical device, and the insertion of spaces between the words to exactly fill the measure. Eleven different sizes of spaces were used in justifying.

The Dow process of justification of 1893 involved the measuring of the composed line, word by word, and a calculating mechanism to divide the shortage by the number of spaces needed between words and the insertion of the proper size of spaces from a space magazine. If required, the mechanism would insert spaces of varying thickness in any line. F. B. Converse's justifier of 1901 was based on a similar proposition, though the mechanism varied.

Temporary word separators were employed by W. J. Ennison and W. H. Honiss in their justifier, invented in 1896. These separators projected beyond the type line and caused a calculating device to record each one as the line containing them passed the counter, the device then, by performing addition and division, replacing the temporary spaces with those of proper thickness to justify the line. Four sizes of spaces were used.

HAND SELECTION.

Alexander Lagerman, inventor of typesetting devices, also invented in 1888 a machine in which unjustified lines could be rapidly spaced out. The



LAGERMAN JUSTIFYING MACHINE.

lines were measured, and the operator by moving a lever caused the temporary spaces between the words to be ejected and the necessary spaces or a combina-

tion thereof to exactly justify the line inserted. Apparatus of this nature was invented by others, but, requiring an attendant operator, was of little commercial advantage.

CUTTING SPACE TIMBER.

One form of mechanical justifier was that proposed by H. C. and S. D. Snoddy, of Greenville, Kentucky, in 1891, they using in their mechanism a strip of wood for space material, and after measurement of the line, causing knives to be set and operated to cut off the size of spaces necessary to justify the line. F. A. Johnson later employed this method, as also did P. H. McGrath, using ordinary leaden material in their machines.

CASTING SPACES.

P. H. McGrath, of Randolph, Massachusetts, in 1891 invented a method of casting justifying spaces in a mold adjusted to the proper width by mechanism operated by devices which measured the line after it was set, inserting the cast spaces in lieu of the temporary ones, he being granted a broad patent in 1898.

F. A. Johnson, of Philadelphia, Pennsylvania, and William Berri, of Brooklyn, New York, invented similar contrivances in 1897, the latter using a series of molds in which to cast the spaces.

PROGRESSIVE SUBSTITUTION.

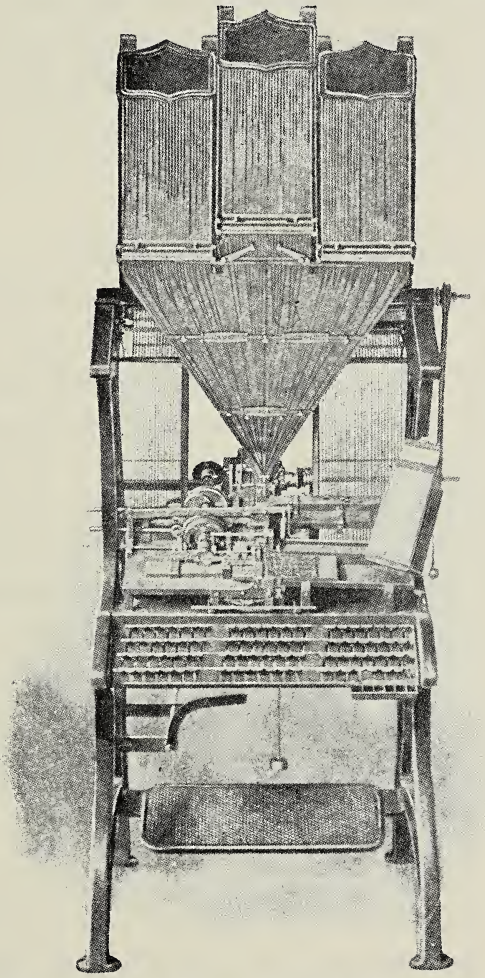
John L. McMillan patented a justifier for single-type machines in 1892, the method being to start with thin spaces and substitute spaces the next size thicker until justification was accomplished.

A patent granted to P. H. McGrath in 1900 was for a machine for justifying a line of type having space holders containing superposed spaces of progressive widths, the thinnest space being inserted between the words and the spaces then advanced until the sizes required were in place.

SELECTION BY WEDGES.

Frank McClintock used steel wedges to space out the lines in his type justifier, invented in 1894, the distance to which the wedges were driven determining the size of spaces to be delivered from the space channels to replace the wedges. This was the first employment of the wedge to temporarily justify a line of individual type, the application for a patent having been filed but twenty days prior to that of F. B. Converse on a similar device, McClintock proving priority of invention in the ensuing litigation and being awarded a very broad patent in 1898, which was assigned to the Empire Typesetting Machine Company. In this justifying device, the operator assembles in the line, as composition proceeds, a temporary steel space, wedge-shaped, about two inches in length. The thin portion of the wedge is projected between the words, and on completion of the line the touch of a key causes the line to be advanced to a point between two fixed jaws, where the wedges are pushed upward until the measure is exactly filled. The distance to which the wedges are pushed determines the selection of the size of spaces to be inserted throughout the line, and the wedges are automatically withdrawn, one by one, and the type spaces

of proper thickness inserted. Six sizes of spaces are used, each contained in separate channels above the justifying mechanism. After each wedge is with-



EMPIRE COMPOSING MACHINE, WITH MC CLINTOCK JUSTIFIER.

drawn and the permanent space introduced, the remaining wedges are given a further push, thus compensating for any discrepancy between the space-

wedge withdrawn and the type-space inserted, the next size of space being then selected by the following wedge if the advancement of the wedges indicated the necessity of it. In the accompanying illustration the McClintock justifier is shown as it is now incorporated in the Empire typesetting machine. J. D. Chalfant, of Wilmington, Delaware, secured a patent on a similar device in 1898.

HOLLOW SPACES.

C. W. Bowron, of Oshkosh, Wisconsin, also attempted the automatic justification of individual type in 1896. The plan invented by him consisted in assembling false hollow spaces in the line, these serving to keep the words apart and permit the proper justifying spaces to be dropped into them and remain between the words when the false spaces were automatically withdrawn. A dial indicated to the operator how much the line lacked of justification, he then calculating which space keys to strike, these spaces being released into a common receptacle, the passage of the hollow temporary spaces below this magazine releasing the justifying spaces one at a time and allowing them to enter between the words. The hollow tubes were then withdrawn and the line advanced to the galley. In an improvement patented in 1900 he used hollow false spaces and a mechanism which, after calculating the size of spaces necessary, released a ball from a hopper and directed it into certain channels where each ball caused the proper width of space to be deposited in the line through the false hollow spaces.

SUBTRACTION OF SPACES.

In a justification scheme of H. J. S. Gilbert-Stringer and F. Wicks, of London, England, patented in 1900, two spaces of one unit thickness each were assembled between the words and the line overset, a gauge indicating to the operator how many units must be extracted to justify it. Certain keys were thereupon depressed and one of the two spaces ejected from between as many words as necessary.

REDUCING BY CUTTING.

Another plan of justification has been incorporated in a machine by these inventors recently placed on exhibition in London. Under this system, a type space, an em quad in thickness, is assembled between the words, the line measured to determine the amount of overset and then transported to a milling cutter which reduces the spaces to a thickness which will exactly justify the line.

Type Casters and Setters

Inventors of typesetting machines early realized the desirability of being independent of the typefoundry in supplying the magazines of their composing machines, and great strides have recently been made in this direction. Dispensing with distribution and providing their machines with new type always, they overcome two undesirable features incident to the use of foundry type.

WESTCOTT'S DIRECT-CASTING MACHINE.

Charles H. Westcott, of Elizabeth, New Jersey, was the originator of a new style of composing machine in 1871, he building a machine in which the type was cast as its keyboard was operated, this being the first combined typesetting and typecasting machine. In this apparatus the dies were mounted on levers or arms similar to those of an ordinary typewriter, and the action of the keyboard caused the corresponding matrix to be swung to the central point and clamped before a pot of molten metal and a single type cast therefrom, this operation being repeated at each stroke of the keys. Westcott's machine was exhibited at the Centennial Exposition at Philadelphia in 1876.

FOWLER'S TYPE CASTER AND SETTER.

The first improvement over Westcott's device was made in 1894 by Joseph C. Fowler, who provided a typecasting arrangement to cast the type and deposit it directly into magazines, from which it could be assembled in the usual manner. He had a mold for each type character, and a matrix adjacent thereto, adapted to lock against the mold and receive the charge of metal from the metal-pot, the type being then ejected into the channels directly beneath, keeping them always supplied. Compressible spaces were subsequently used in this machine to effect justification of the lines.

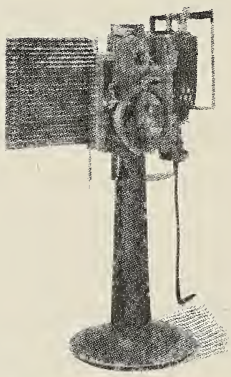
BERRI'S TYPECASTER.

An unusual form of typecasting apparatus was that proposed by William Berri in 1896. He assembled a line of matrices with mold dividers between each letter, thus forming a plurality of mold cells, into which the metal was cast to form a line of single types. Wedges were used to justify the line of matrices.

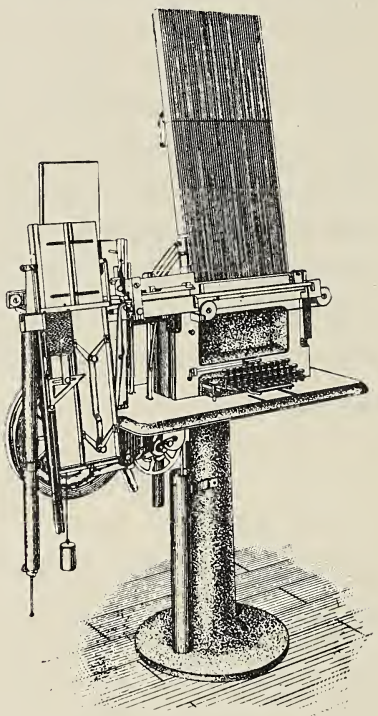
JOHNSON'S SETTER AND JUSTIFIER.

In 1897 Frank A. Johnson invented a composing machine which he proposed to supply with type made in a special automatic casting apparatus, separate from the composing machine. A large number of each type was cast and deposited in tubes ready for the magazine of the setter, the machine casting all the letters and points in regular rotation. In the setter, the types were assembled in the usual

manner, the line automatically measured to determine the amount lacking of complete justification, and the size of spaces necessary cut or sawed from a bar of



JOHNSON TYPECASTER.



JOHNSON TYPESETTER.

metal and deposited between the words in lieu of the temporary spaces.

STRINGER DIRECT-CASTING MACHINE.

A single type casting, setting and justifying machine of a new pattern was invented in England in 1898 by H. J. S. Gilbert-Stringer. The matrices were arranged on the face of an arc of a cylinder which was connected to the finger keys in such a manner that it received a compound motion from these, being

turned partly on its axis and moved more or less longitudinally as the keys were depressed so as to bring the proper matrix into position, this being then pressed against a mold while the molten metal was injected to form a type. This action was repeated for each letter in the line, the type being ejected, dressed and delivered to the spacing apparatus, where compressible spaces were introduced between the words, the line being overset and reduced to proper length by compression.

SMITH'S CASTING AND SETTING MACHINE.

Another single type casting machine which was operated directly by keyboard arrangement was that of M. W. Smith, of London, England, who in 1898 invented a machine in principle similar to Westcott's, although he used a disk carrying four molds in which to cast the type, and provided automatic arrangements to adjust the mold to the size of the matrix brought before it. After a type was cast the disk was rotated and another mold used to cast the next letter, the first type being ejected meanwhile. Justification was not provided for.

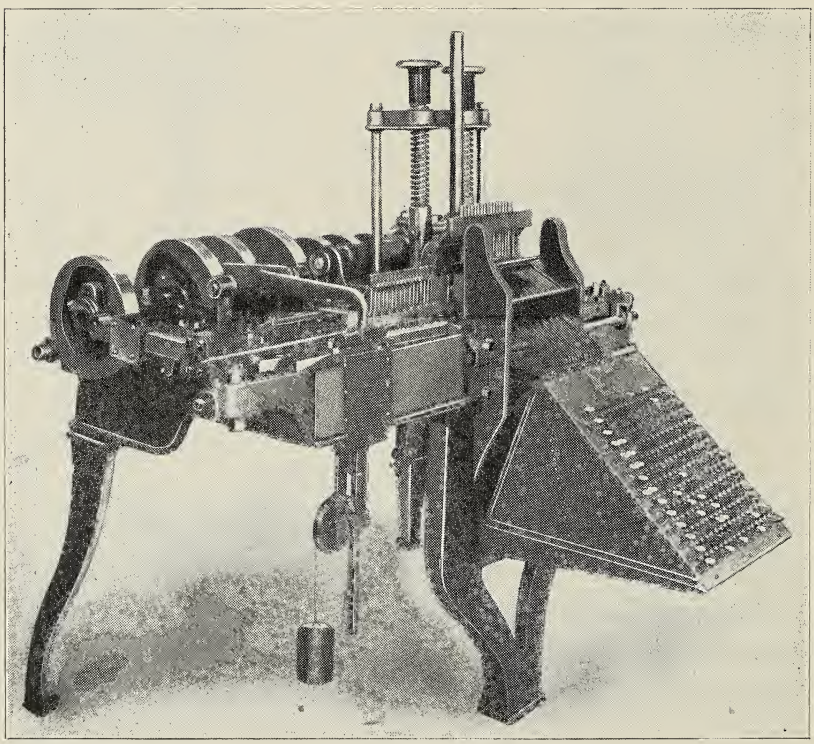
THE STRINGER.

Yet another single type casting and composing machine is the invention of H. J. S. Gilbert-Stringer, of London, England. This is an adaptation of either Monoline or Linotype machines to cast individual type, and is accomplished by assembling a line of matrices and spacers in the ordinary manner, but thereafter advancing each letter of the line to the

mold, which adjusts itself according to the width of the matrix presented and casts a single type, the spacers, which had previously been driven upward to wedge the line to its full width, being in like manner presented to the mold while held in the position which would cause the proper space to be cast, the product of the machine being a justified line of single type. The patents were taken out in 1902.

THE CASTOTYPE.

J. C. Fowler and J. C. Fowler, Jr., of Baltimore, Maryland, in 1902 produced a combined type casting,



THE CASTOTYPE.

setting and justifying machine embodying some new features. A series of molds is provided, the matrices being similar to those employed in the Monoline machine, all the letters of a certain width on a single bar. The operation of the keyboard causes the corresponding matrix to be lowered to register with its mold and a single type to be cast. In case of characters running from right to left on the keyboard these can be operated at one stroke and the letters cast simultaneously; otherwise the casting mechanism operates and casts a single type at each stroke of the keys. Soft metal quads are employed as spaces and the line overset and end pressure applied to bring the line into the proper measure. The complete line is then passed betwen two trimming knives which remove any metal protruding from the crushed spaces.

BROOKS' MACHINE.

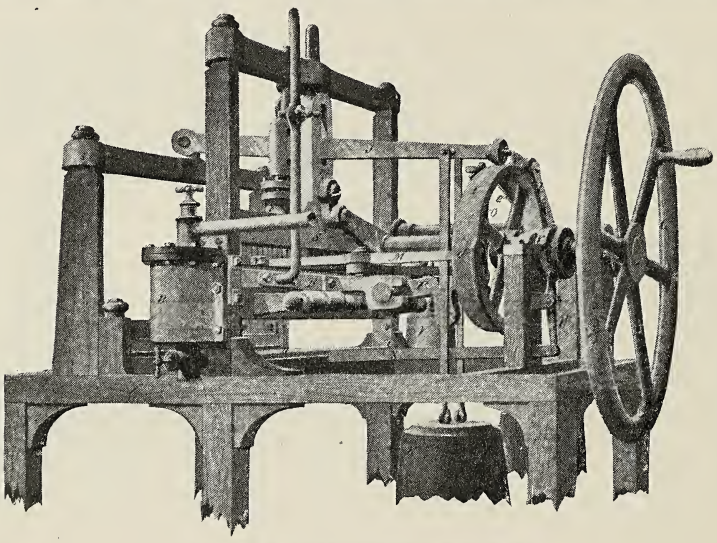
B. A. Brooks, of Brooklyn, New York, is the latest to invent a machine of this order, he taking out a patent in 1904 on a machine which caused a duplicate type to be cast and deposited in the type magazine whenever one was ejected in the course of composition. There was one mold and a corresponding type die for each letter. A measuring and calculating device computed the size of spaces necessary to accomplish the justification of the line, the casting mechanism proceeding to produce and deposit them in their places in the line.

Typecasting Machines

That printers of the future will be their own typefounders is evidenced by the efforts being made by inventors to furnish them with machines for casting type as required. Logically the printing-office is where the typemaking should take place, and emancipation from present conditions is looked forward to by all printers.

CHURCH'S TYPECASTER.

In 1822 William Church constructed a typecaster in which the letters were cast and deposited in tubes ready for his composing machine at the rate of



CHURCH'S TYPECASTING MACHINE.

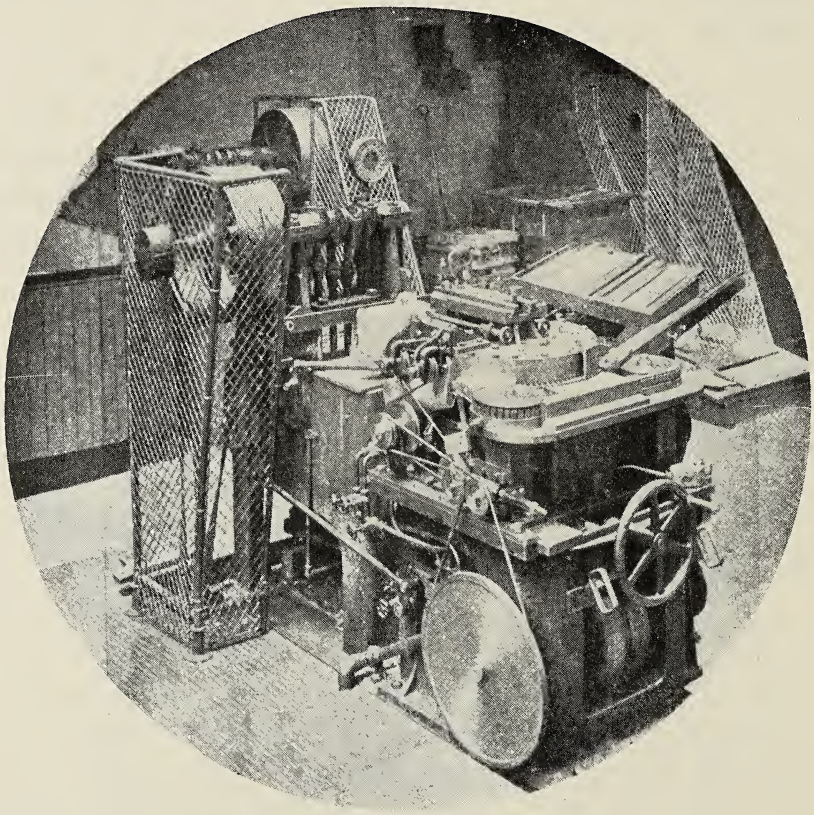
75,000 types per hour, the object being to cast new type instead of distributing dead matter. He used a plurality of molds with a matrix for each adapted to lock against it while the type was being cast. A whole font was cast at each operation. Joseph Mazzini's patent of 1843 covered a machine for a similar purpose. Both of these patents were taken out in England.

THE WICKS ROTARY TYPECASTER.

The Wicks Rotary Typecaster, which is the invention of an Englishman, Frederick Wicks, was brought to this country in 1902, after demonstrating its economical advantages for several years in England. The product of the Wicks typecaster may be used in any typesetting machine using individual type, and in this connection offers a solution of the distribution problem, as the type is produced so economically and rapidly that it is cheaper to return the type metal to the rotary machine after use and replenish the composing machine with new type.

In the Wicks process, type is cast at the rate of sixty thousand letters an hour. In two hours the rotary typecaster can cast enough type to last a composing machine all day. The type is cast in complete fonts, in proper proportion, and is said to be true and accurate as may be. It requires no dressing after being cast, but is merely divided into character groups and sent to the composing machine. The casting of the type is effected by forcing a stream of molten metal from a pot, containing about a thousand pounds at a temperature of 700 degrees, into the type

dies, which are mounted on a chain which revolves at a speed of twenty-five miles an hour before the nozzle of the pot, presenting each mold in turn to the stream of metal, and depositing the resultant type in a channel ready for the composing machine or the type case. The Wicks Rotary Typecaster requires three

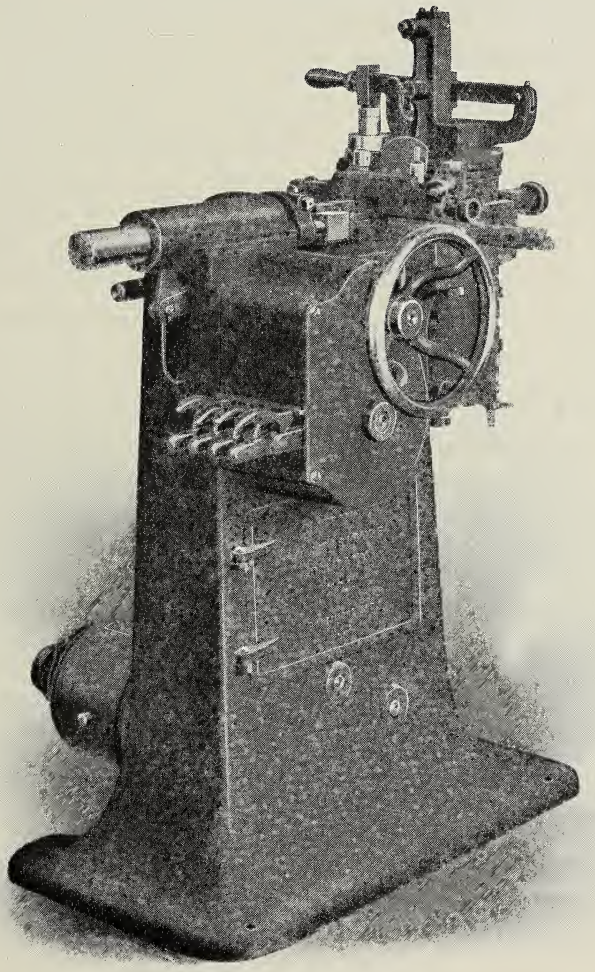


WICKS ROTARY TYPECASTER.

horse-power and the services of a man and a boy, and occupies thirty square feet of floor space. The machines themselves are not for sale — only the product.

COMPOSITYPE SORTS CASTER.

A typecasting machine adapted to supply a printing-office with fonts or sorts as needed was conceived in 1899 by a trio of Baltimore inventors, Frank H. Brown, George A. Boyden and John E. Hanrahan, who after years of experiment have produced a machine



COMPOSITYPE SORTS CASTER.

which has been put into practical operation in a number of printing-offices. The machine is compact, being 52 inches high and requiring a floor space of but 27 by 45 inches. It weighs about eight hundred pounds, and a quarter horse-power motor is used to drive it. Any size type from 6 to 36 point can be cast, and quads and spaces from one point up, at a speed of about twelve types per minute. The change from one size to another occupies two or three minutes. The matrices are supplied at $20 per set and the machine leased for $500 per year. The matrices are produced by electrotyping foundry type and mounting the shell in a small brass plate, which is so accurately fitted as to permit the matrix to be quickly clamped in place in the machine without other adjustment. The mold can be quickly changed by removing or inserting different thicknesses of liners for changes in set or width, and inserting different molds for changes in body, these changes being "self-adjusting." The matrix is clamped into place in a reciprocating ram which carries the matrix to and from the mold, the casting, ejecting and trimming movements proceeding automatically, the type being delivered on a slide ready for the case. The machine is called the Compositype Sorts Caster.

Type-bar Machines

Allied to both single-type and slug machines is a class partaking of elements of both—a class of machines assembling single types but producing as a finished product a type-bar. Short, special type are used in these machines, and after assembling are mounted on prepared or otherwise formed bases to bring them to type height.

THE CALENDOLI.

In 1893 Father Calendoli, a Dominican monk, of Paris, France, announced his invention of a type-setting machine embodying this principle. Long vertical channels contained the type, which was specially cast for the machine, being shorter than ordinary type and having a deep groove in the bottom, adapting it to be mounted on a prepared base, which practically made a separate slug of each line of type. The type was released by the means of electrical circuits, closed by the operation of the keyboard, which was a leading feature of the machine. There were 575 keys on the Calendoli keyboard, the lower-case alphabet being repeated fifteen times in systematic groups, the capitals three times and the points five times. The letters most used were duplicated several times in each group, so that the opera-

tor might choose the key nearest his hand in forming words. A number of keys could be struck at one time, but in releasing the keys the fingers were raised one at a time, the type being ejected as each

THE CALENDOLI.

finger was raised. The grooves in the bottom of the type assisted in the assembling of the letters, they being supported on a guide rail while assembling

and transferred directly on to the prepared bases, line by line. Means of justification were not provided for.

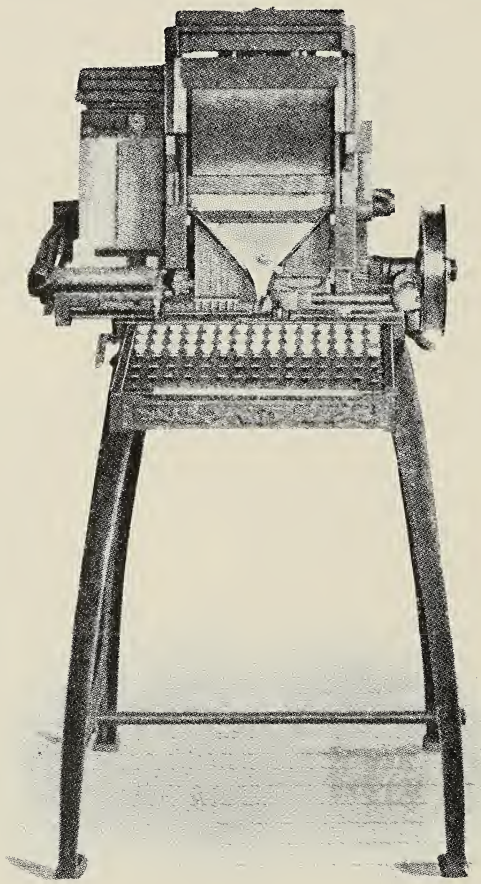
KEMP'S TYPE-BAR MACHINE.

William Kemp, Jr., was the next inventor to adopt this idea, his machine of 1894 showing a method of casting and assembling short, special type and mounting them in lines on prepared bases. He proposed to use a type-wheel carrying the dies deeply sunken on its periphery and, in conjunction with a mold to form a tenon joint, cast the type and deposit it on the bases prepared to receive the lines.

THE COMPOSITE TYPE-BAR MACHINE.

Another machine of the type-composing, bar-forming class was developed by Lucien A. Brott, of Brooklyn, New York, in 1896. Following the lines of Fowler's typecasting machine, Brott constructed a novel apparatus which he called the Composite Type-bar machine, which was probably the most compact typesetting machine ever built. It occupied but eight square feet of floor space, weighed 250 pounds and was run by one-tenth horse-power. The machine was provided with a series of molds, one for each letter in the alphabet. Metal was cast into these molds and the type deposited directly into the channels of the composing mechanism, keeping them supplied. The improvement over Fowler's invention was in the novel means provided for the justification of the lines. The type was shorter than type-high to allow for the subsequent casting around the base of

the line, and was withdrawn from the channels by the operation of the keyboard. Short steel wedges were brought between the words, these lying at right angles to the length of the type. When the



COMPOSITE TYPE-BAR MACHINE.

line was completed it was justified by the wedges and lifted to the metal-pot, were molten metal was cast upon the bottom of the type and between the words, forming a " composite type-bar." The wedges

were returned to their magazine and the line of type, now transformed to a bar, deposited on the galley. The casting of the type proceeded continuously, the entire font being cast at each operation, the molds rotating and depositing the cast letters in their magazines. In the event of any channel being full, the ejector for that channel was automatically thrown out of operation and the type remained in the mold, thus preventing subsequent casts of that particular character until the supply was depleted.

A company was organized with a large paid-up capital and an experimental machine constructed, though no effort has been made to place the machine on the market.

GALLY'S MACHINE.

Short, special type was used in 1898 by Merritt Gally in the production of type-bars. The type was manufactured specially with deep grooves in the bottom. These type were assembled with wedges between the words and slid on to a special base to bring them to type height, when, after justification by the wedges, pressure was applied to the sides of the type to swage them in their position on the bar.

Impression Devices

Notwithstanding the fact that the impression form of composing machine has proven to be the greatest delusion in the art of mechanically setting type, and the records shown nothing but abandoned wrecks of attempts to construct machines on this order, misguided inventors are still working along this line, though the inherent difficulties in the method are apparently insurmountable. Some of these machines impressed the characters letter by letter; some assembled male dies and made the impression a line at a time. Papier-mache, soft lead, wood and other materials were used to form the matrix. The impressions made were far from perfect, while in impressing letter by letter, lateral crowding and distortion were always present.

IMPRESSION LETTER BY LETTER.

As early as 1858 J. McElheran proposed to impress dies into a soft material and form a matrix letter by letter, thus doing away with typesetting.

SPECIAL BASIS.

D. B. Ray, of Galena, Illinois, in 1859 patented a machine in which the dies were impressed in soft metal mounted on a base portion of harder material, which he called an "apparatus for punching stereotype plates a letter at a time."

IMPRESSION LINE BY LINE.

The impossibility of avoiding distortion of the preceding letter when impressing letter by letter was recognized in 1866 by J. Pauling, who proposed to assemble a line of male dies and make the impression a line at a time. Then followed attempts to emboss the characters and print directly from the type so formed.

GALLY'S INVENTIONS.

The justification of the lines of dies was the stumbling block of all until 1872, when Merrit Gally, of Brooklyn, New York, in many respects a most remarkable inventor, patented a machine which provided for justification of the lines by introducing graduated wedges between the words and advancing them until the line filled the measure. This was the first employment of the wedge for the mechanical justification of type. Mr. Gally's inventions cover a wide range of labor-saving devices, he having had over five hundred patents granted him on various inventions, ranging from piano players to printing presses, typesetting machines and telegraphic apparatus.

SCHUCKERS' WEDGE JUSTIFIER.

The graduated wedge was next introduced in the machine of J. W. Schuckers, in 1879, this apparatus, like that of Gally's, being an impression machine. In 1885 Mr. Schuckers invented the double-wedge justifier, this latter proving to be the most important

invention in the history of the art. Ottmar Mergenthaler filed an application for a patent on a double-wedge justifier the same year, but Schuckers was decided to be the prior inventor, and the Mergenthaler Company was compelled to buy the rights of Schuckers in order to use this spacer in the Linotype. The price was $416,000, said to be the largest sum ever paid up to that time for a single patent.

RUBBER SPACES.

Later inventors of impression machines, which assembled a line of dies before making their impression in the soft matrix material, proposed to justify the dies by using india-rubber spaces, this being an idea of E. Wright, in 1885. Others used various forms of elastic spring spacers.

MERGENTHALER'S MACHINE.

The most notable inventor to direct his talent to the solution of the problem of composing type by the impression method was Ottmar Mergenthaler, who was engaged in 1878 to construct a machine on this order, and although some success was attained, the attempt was abandoned later.

PETERSON'S MACHINE.

Ole M. Peterson, of Chicago, Illinois, in 1879 filed an application for a patent on an impression form of composing machine, he employing a compressible spring spacer to justify the lines.

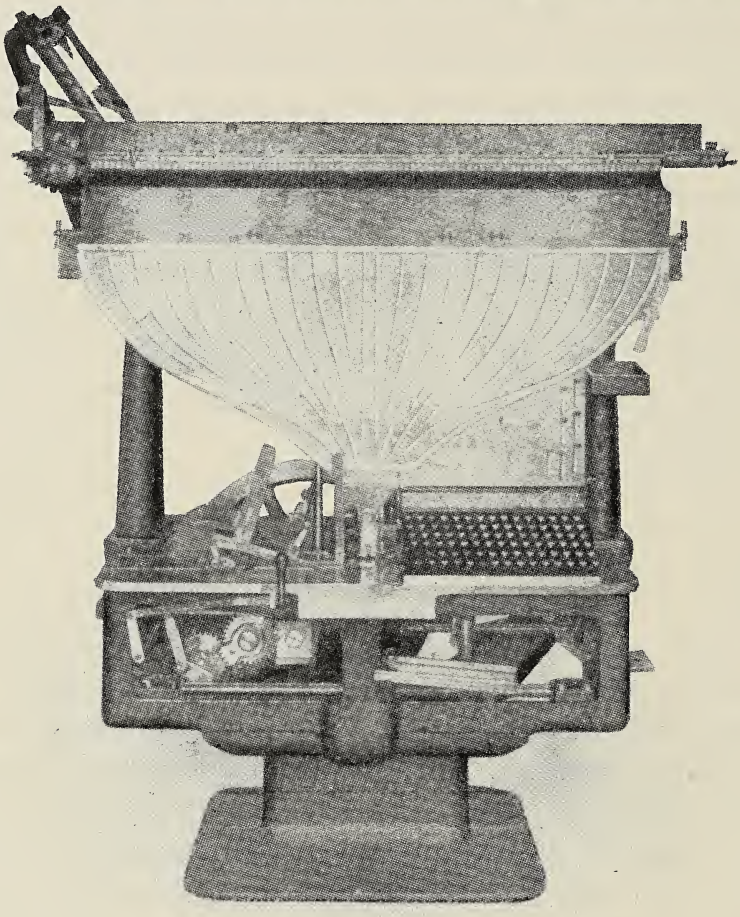
ROGERS' IMPRESSION TYPOGRAPH.

John R. Rogers, of Lorain, Ohio, in 1888 invented the only impression machine which was ever put into practical use. In his machine, which was called the Typograph, the matrices were strung on inclined wires, which converged beneath the keyboard. Each matrix hung from its own particular wire and never left it, there being several matrices of the same character on each wire depending like a metal fringe at the back of the machine. When a key was operated a matrix was released and slid down the wire to the point of assembly. As a means of justification of the line he proposed to employ elastic spaces, made of layers of rubber and metal, compressing the line after oversetting it. The line of of composed dies, which were of the male or cameo order, were then impressed into a soft metal blank. Later the double-wedge justifier was employed. In order to avoid Mergenthaler's patents on a combined setting, casting and distributing machine, the actual casting of the lines was performed in a secondary apparatus, the soft metal matrix strips being fed into an automatic machine which cast a slug from each matrix. A third apparatus was necessary to form the soft metal blanks. A few machines of this style are still in operation. A similar apparatus was patented in 1896 by C. Forth, of Cleveland, Ohio, and by C. J. Botz, of Sedalia, Missouri, in 1897.

ST. JOHN TYPOBAR.

The St. John Typobar, a machine which made lines of type from cold metal by compression, was

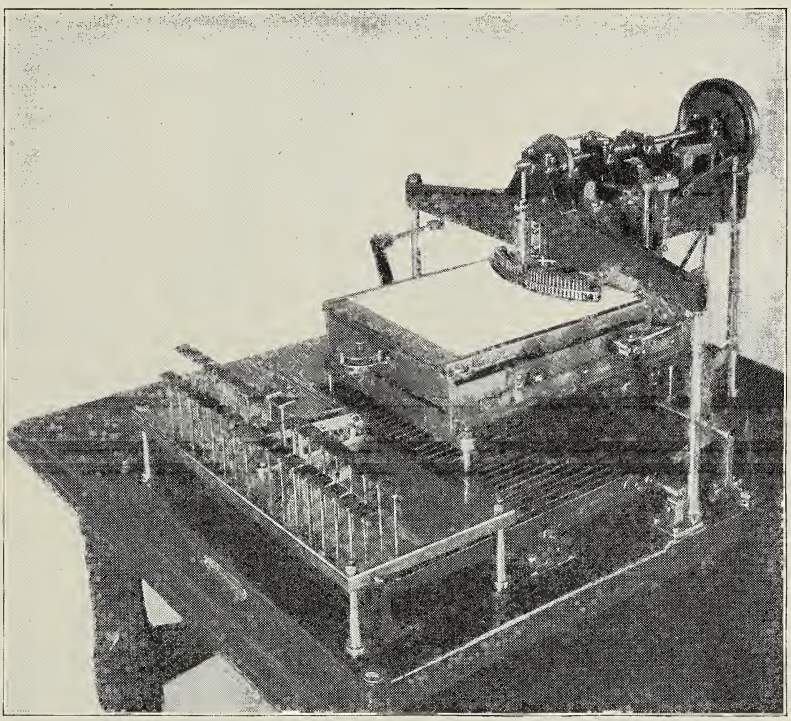
invented by R. H. St. John, of Cleveland, Ohio, in 1890. Since then the machine has undergone many modifications. The matrices, which were of hardened steel, were stored in banks in the magazine, and were



ST. JOHN TYPOBAR.

released by the operation of the keyboard and assembled in a line. The line of intaglio matrices was then transferred to where a type-bar, made up

of a soft metal strip attached to a steel base, was presented to the matrices, where, after justification of the line by means of single-wedge spacers, the matrices were impressed into the soft metal, embossing the characters on the slug. The line was then ejected between a pair of knives, which trimmed off



KLETZKER'S IMPRESSION MACHINE.

the surplus metal and delivered it to the galley, the matrices being returned to their chambers automatically. The Typobar required about twenty square feet of floor space and was run by a half horse-power motor. The slugs were, after use, run through a small device which removed the type-metal face and

left the steel base ready to be used over and over in the composing machine. It was also necessary to supply the composing machine with the soft metal blanks. A feature of the St. John Typobar was the fact that there were no cams in its make-up, rotary devices being employed throughout.

JOHNSON'S IMPRESSION MACHINE.

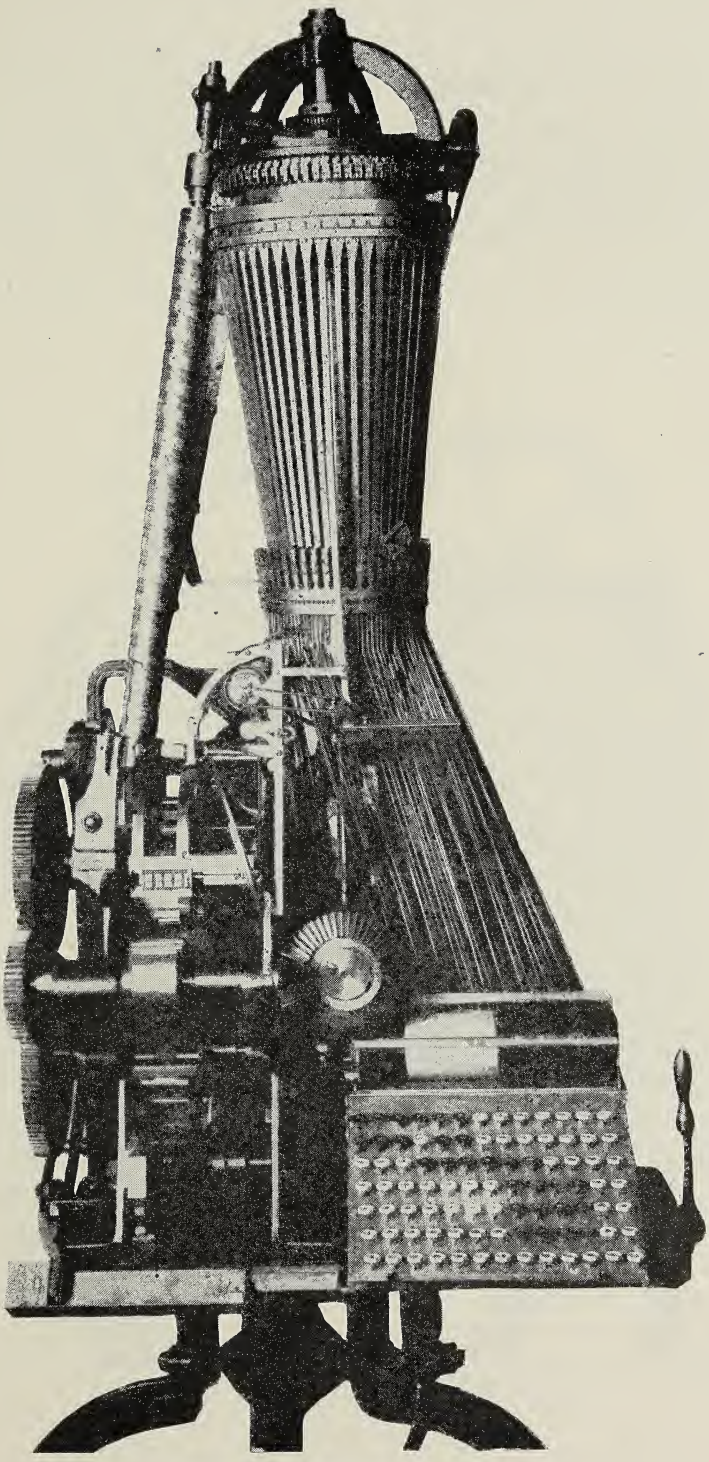
Frank A. Johnson, inventor of type casting and setting machines, also patented an impression apparatus in 1891.

KLETZKER'S IMPRESSION MACHINE.

A keyboard machine for the impression of dies in a hard, prepared cardboard was invented in 1892 by A. J. Kletzker and J. G. Goesel, of St. Louis, Missouri, and though never placed in actual commercial use, was built and operated. The illustration shows the construction.

FOWLER'S IMPRESSION MACHINE.

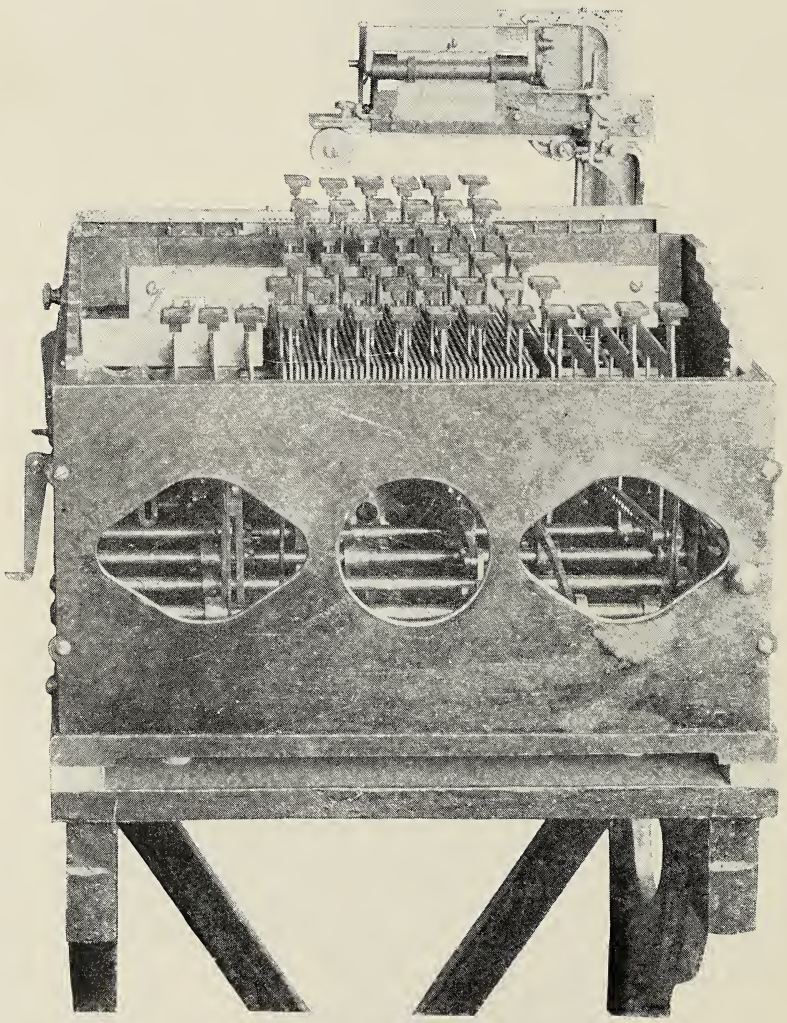
Joseph C. Fowler, of Baltimore, Maryland, in 1894 invented a slugcasting machine which used male dies to make an impression in soft metal, this forming the matrix from which the line was cast, but an interference with the invention of P. T. Dodge in 1893 on a similar adaptation of the Linotype prevented Fowler's machine being marketed. It was proposed to use as a justifying device a pair of steel spring plates, normally expanded, the line being overset and then brought to the proper length by compression.



FOWLER'S IMPRESSION MACHINE.

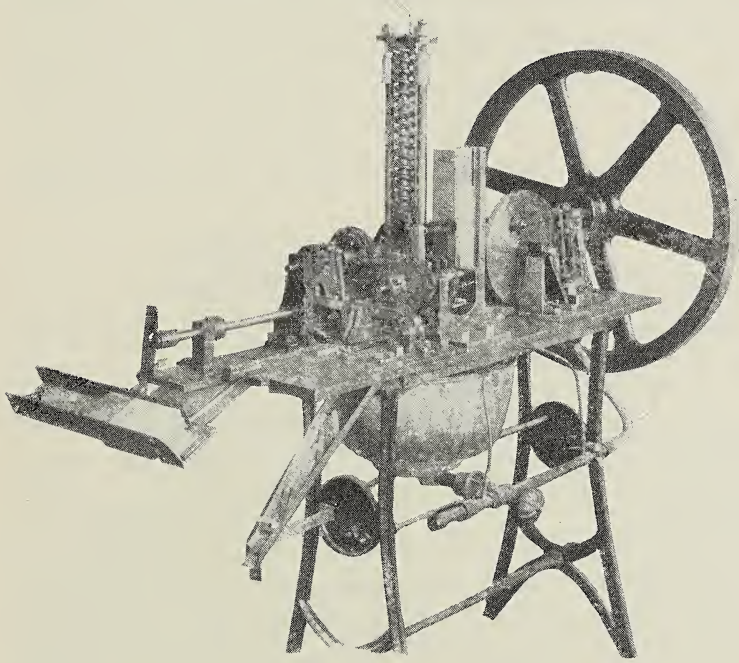
SEARS TYPOMATRIX.

In 1898 Charles Sears, of Cleveland, Ohio, more nearly approached the solution of this problem than any of his predecessors. His discovery of a material



SEARS TYPOMATRIX — INDENTING APPARATUS.

into which the punches could be impressed letter by letter without lateral crowding was a long step in advance. Mr. Sears, who had been a wood engraver, and had used the end fibers of wood on which to cut his blocks for printing, used this material to form his matrix. Blocks of wood were cut to the required



SEARS TYPOMATRIX — CASTING APPARATUS.

dimensions to take an impression for a single line, and an impressing device was constructed, in which steel punches were operated by a keyboard to make the matrix.

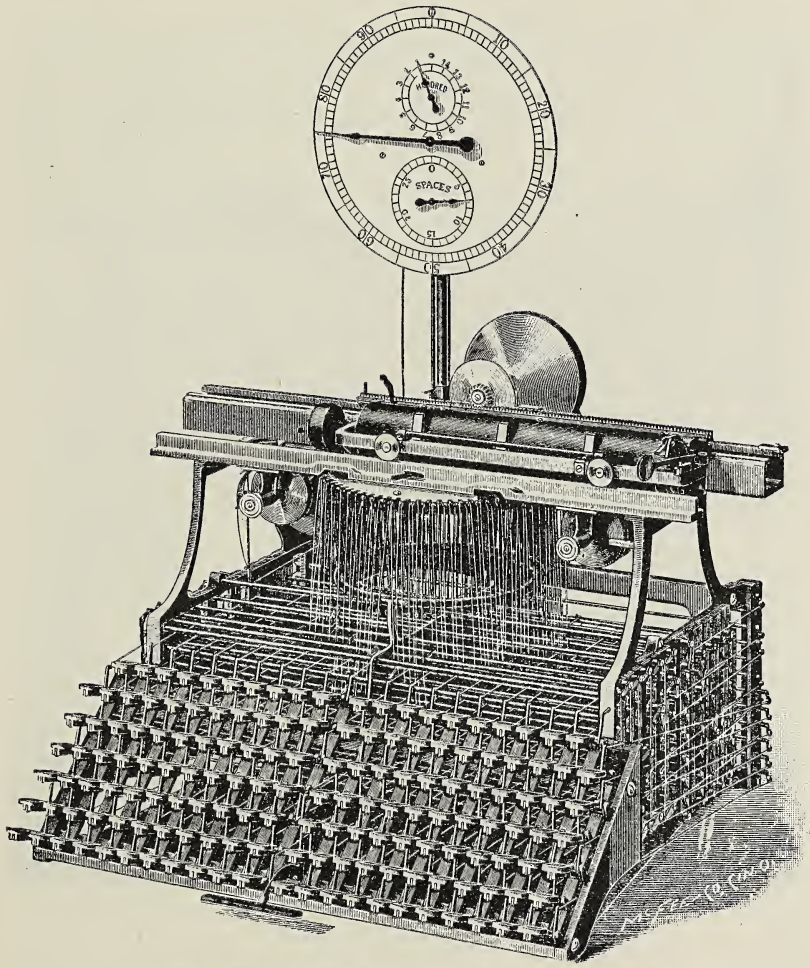
The first machine constructed was heavy, slow and clumsy, and was discarded almost before completed, and a second apparatus, shown in the illus-

tration, was built. This proving satisfactory, a separate casting machine was invented, in which slugs could be cast from the wooden matrices. These were placed in an upright feed-chute and were fed automatically before a pot of molten metal and lines of type cast from them at the rate of sixty slugs a minute. In working out a means of justification which was not covered by the inventions of others, Mr. Sears evolved a differential feed for the carriage of a typewriter, the carriage moving only the width of the letter operated, and this idea formed the nucleus of a later invention of his in the typesetting-machine field.

HEATH MATRIX TYPOGRAPH.

The Heath Matrix Typograph is the latest impression form of composing machine to make a bid for favor, this machine first appearing in 1892, and but recently renewing activities. It is the invention of T. T. Heath and A. N. Verdin, of Glendale, Ohio. A pad of impression material is carried in an upright support and a die case containing 140 male punches is arranged to move to and fro to bring the proper matrix in position as the keyboard is operated. The punch is driven into the matrix material to form a letter. Each letter is on the unit system and the matrix material is arranged to feed a corresponding number of units to the left after each punch is impressed. It was proposed to equip a typewriter with a similar feed mechanism on which the copy could be prepared and, at the termination of each line, indicate by how much the normal spaces

should be increased or decreased to bring the line to a justified condition. The operator of the secondary machine, in which the impressing of the

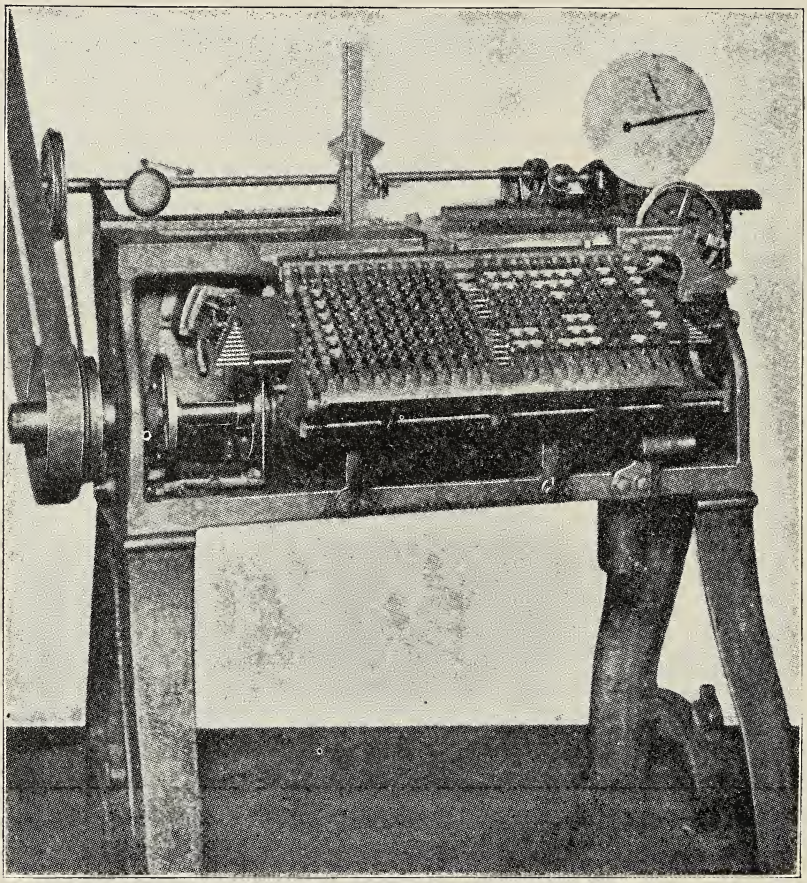


HEATH MATRIX TYPOGRAPH — KEYBOARD JUSTIFIER.

matrix material was done, by using this as copy, could produce accurately justified lines.

The die case of the Heath Matrix Typograph is removable, and to change to another size of type

another case can be substituted and a shift lever moved to cause a corresponding change in the matrix-feeding mechanism.



HEATH MATRIX TYPOGRAPH.

Upon completion of the matter, a stereotype is made of the whole page, instead of casting lines or slugs. The Matrix Typograph is designed to handle at least six different sizes of characters, the steel punches being separate pieces and easily changed.

Slugcasting Machines

Slugcasting machines have enjoyed a greater measure of success than any other form of composing machine. Invented at a time when there was no pronounced competition from individual-type composers, slug machines were hailed as the salvation of the printer, and the revolution they created in the composing-room is all the more astonishing when the well-known conservatism of printers is considered. In daily newspaper work, the slugcasting machine is probably ideal, where one size of type in one measure or width of line is the rule. They have occupied this field uncontested, but it is in the book-printing office that their limitations are most pronounced. Proofs can not be corrected unless the machine happens to be at the moment engaged on similar matter, and the delay consequent on changing to the various sizes of type used in the average book-printing office is a serious handicap. Tabular work requiring vertical brass rules (a large amount of which is encountered here) is still the especial province of the hand compositor, while the inflexibility of slugs in the bookroom makes it certain that the book printer awaits with impatience the perfection of a method which will meet his exacting requirements.

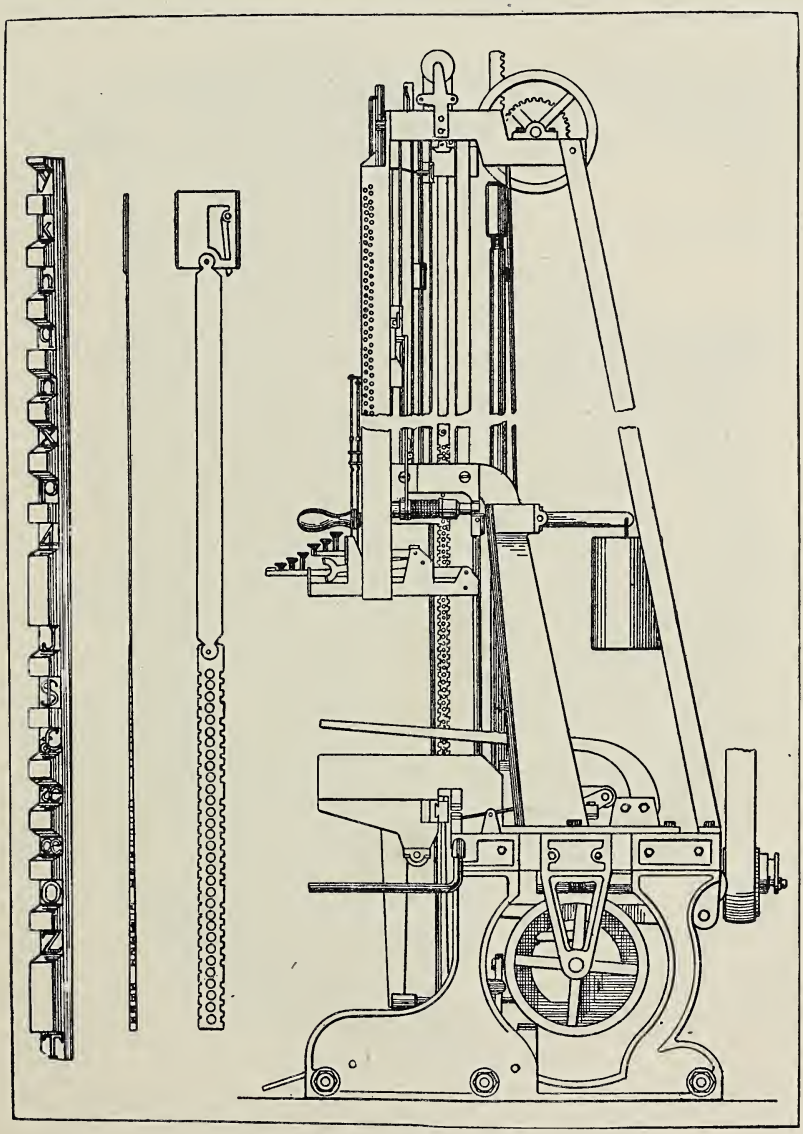
THE LINOTYPE.

To Ottmar Mergenthaler belongs the honor of being the original inventor of direct linecasting machines. The Linotype was the culmination of seven years of fruitless struggling to produce a machine to displace hand composition by various means. Transfer processes, impression letter by letter and line by line into papier-mache, all had their place and use in developing the inventor's mind and preparing it for his crowning success.

In 1884, abandoning all attempts to produce a machine on the lines previously prosecuted, Mergenthaler conceived the idea of assembling a line of dies or female matrices and casting into them molten metal to form a complete slug or line of type. Two machines were built and the idea proven entirely practicable. The matrices in these machines were stamped on the edges of upright bars, each bar containing the letters of the entire alphabet, the operation of the keyboard acting to set up stops which allowed these bars to descend to the proper distance, when a cast was taken from the aligned matrices. The wedge justifier, over the invention of which litigation afterward developed, was incorporated in the second machine built, in 1885.

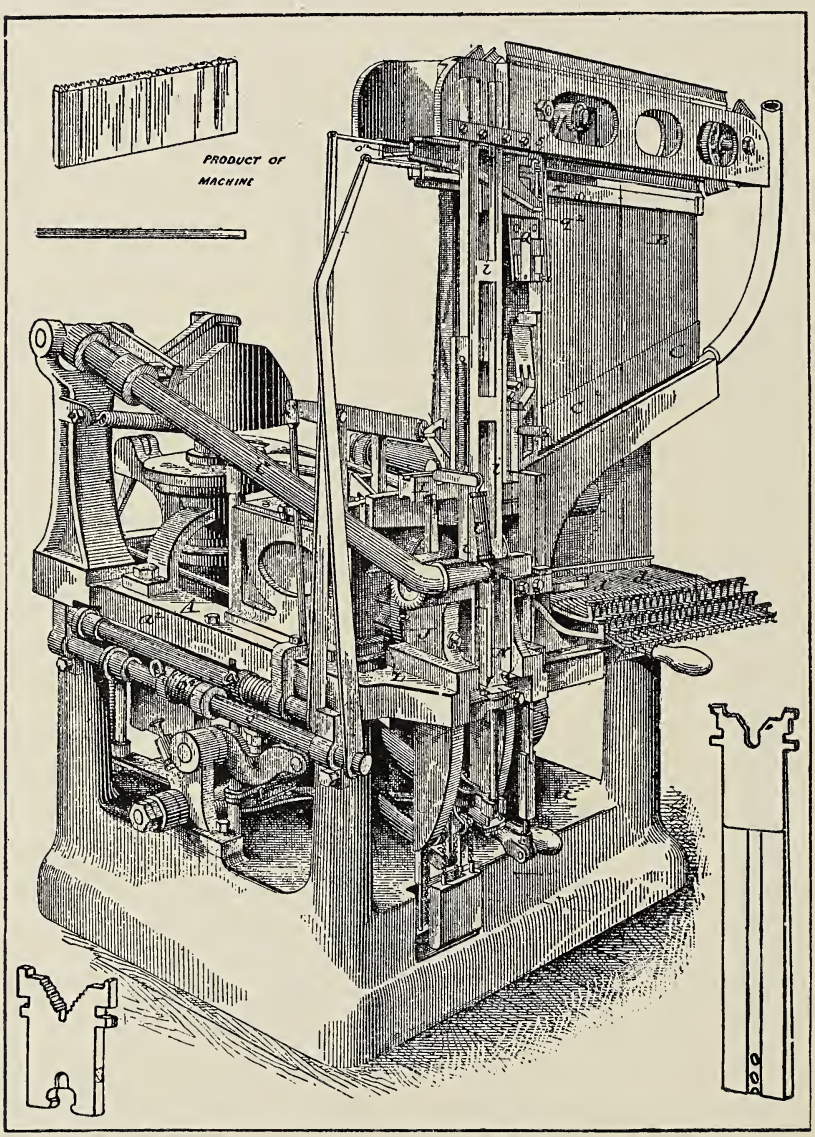
The impossibility of correcting errors as soon as discovered led to the conception of the independent matrix machine, which was next built in 1885, and this marked the advent of the Linotype as a new factor in the printing world. Over two hundred machines of the new pattern were constructed, sixty of which were sent to England, leading newspapers

in both countries installing them. This style of machine would scarcely be recognized as a Linotype by users to-day. The matrix channels were upright tubes, an air blast was required to blow the matrices



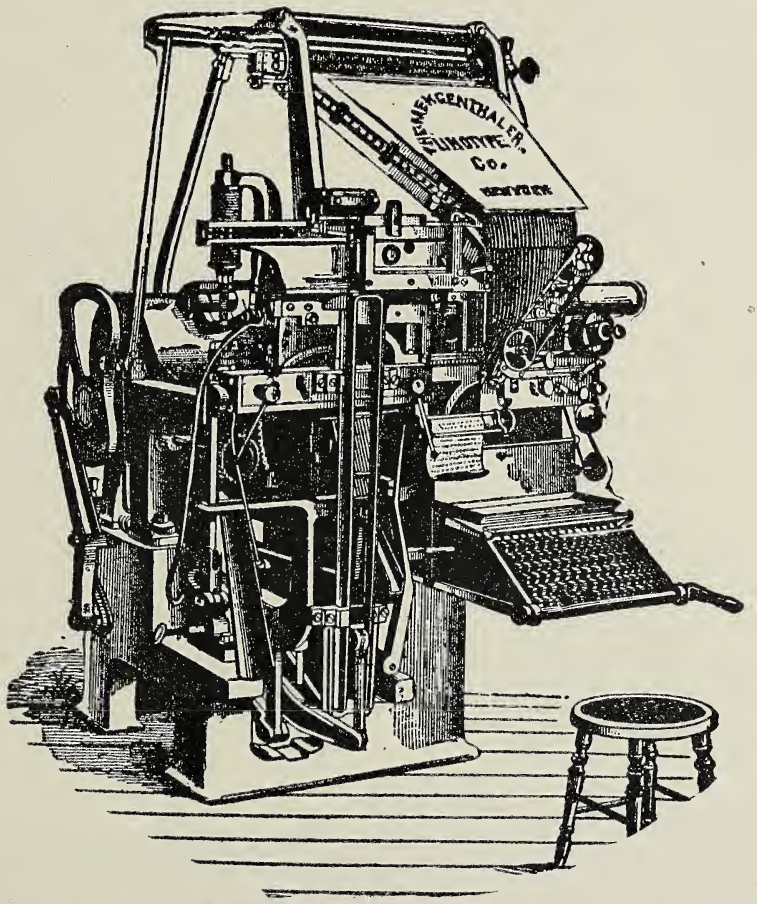
THE LINOTYPE — 1884.

into the assembler, and electricity was employed in its operation. These objectionable features were eliminated in the next pattern invented by Mr. Mergenthaler in 1890. This machine was a vast



INDEPENDENT MATRIX LINOTYPE — 1885.

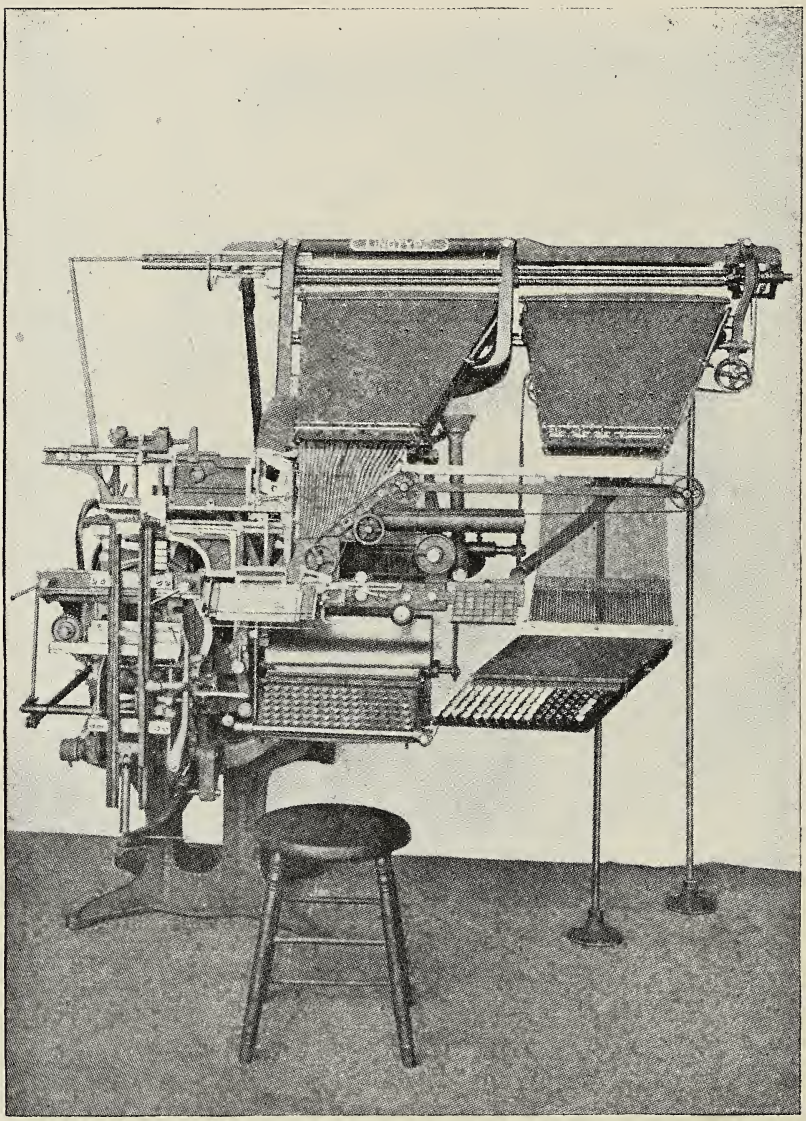
improvement over the previous style, and with the exception of its square, massive base, weighted justification levers, and other minor details, resembled the present form of Linotype. Hundreds of machines of this pattern were constructed, and found



SQUARE-BASE LINOTYPE — 1890.

ready sale. Factories were established in Toronto, Canada; Manchester, England; and Berlin, Germany, the American factory being removed from Baltimore to Brooklyn, New York. Mr. Mergenthaler's active

connection with the company ceased at this time though he continued to make improvements on the machine until the time of his death, which occurred in 1899. Under his contract with the various pro-



TWIN LINOTYPES, WITH STEP JUSTIFICATION.

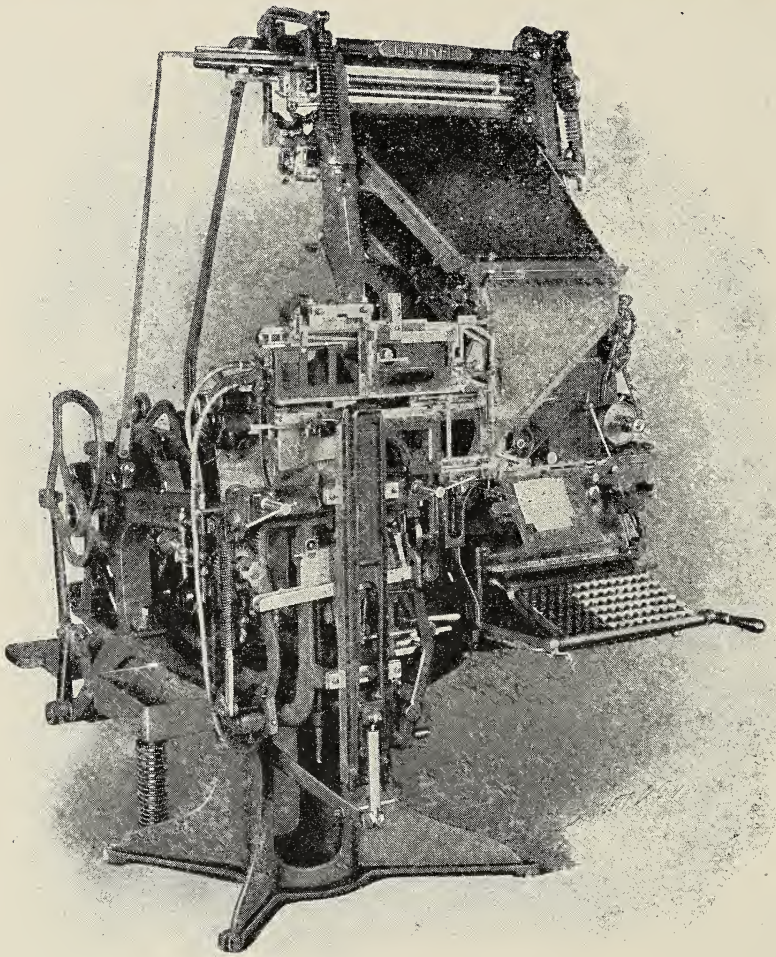
motors of the Linotype, the inventor received ten per cent of the cost of building the machines made in this country until the year 1890, when a royalty of $50 on each machine sold was accepted in its stead, which royalty continues to his heirs.

To avoid the use of the double-wedge justifier, which was then in litigation, in 1894 Mr. Mergenthaler invented and built 225 machines equipped with a step-justifying device, using a graduated single wedge, this device giving uniform satisfaction to its users, but this construction was discontinued when the patent in question was purchased by the Linotype company.

Another style of Linotype was invented by Carl Muehleisen, superintendent of Mr. Mergenthaler's factory in Baltimore. This was called the "Twin" Linotype, it being equipped with two magazines and two keyboards, side by side, but assembling the matrices at a common point, the idea being to increase the capacity and range of work done by the machine, a single magazine containing but ninety characters. Several of these machines went into use, but the invention of the two-letter matrix simplified the process and arrived at practically the same result.

Step by step the Linotype has developed as experience directed, and improvements are still going on. The symmetrical column base has improved its appearance, while the product has been gradually perfected until little is left to desire in this respect. The two-letter matrix, universally adjustable molds and quick-change attachments bring all classes of

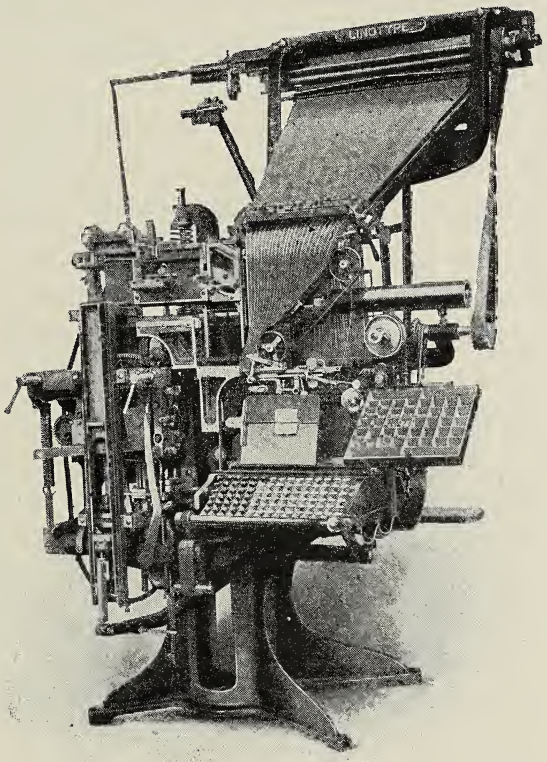
straight composition within its range, while experiments are being conducted with a view of enabling tabular matter to be set which requires vertical brass rules. Double-magazine machines are now con-



DOUBLE-MAGAZINE LINOTYPE.

structed, so arranged that by the moving of a shift lever matrices may be drawn from either magazine at will, they being separated by the distributer and

returned to their proper magazines. The latest Linotypes permit any size of type from 5 to 14 point to be composed in any length of line from five to thirty ems pica. Fifteen different languages are now set on the Linotype in as many different countries.



THE LINOTYPE.

Linotypes are so universally used that the mode of their working is familiar to nearly every one. Briefly stated, the operation of the keyboard releases a small brass die, representing the letter, which falls by gravity to the assembling point. Long steel wedges are dropped between the words, and the line

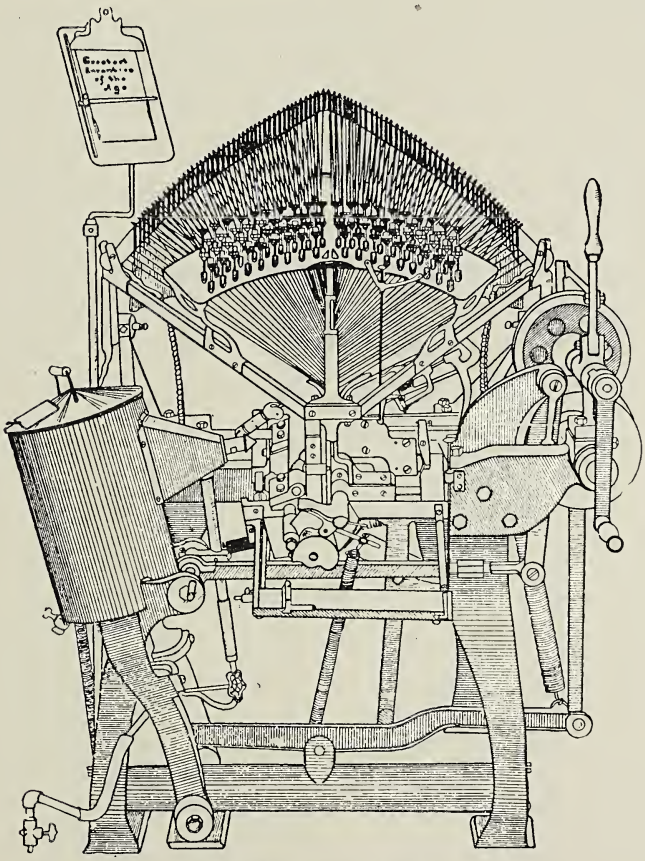
when full is conveyed to a point in front of a pot of molten metal, where the wedges are driven upward to justify the line and the dies presented to the mold which froms the body of the slug. After the cast is made the matrices are elevated to the top of the machine and returned to their proper channels to be used over and over. As each matrix for a certain character has a certain number of teeth on its upper edge from which it depends from rails which end when its proper channel is reached, the matrices drop unfailingly into their respective compartments. The slug, bearing the characters received from the matrices on its printing edge, is trimmed by knives on the bottom and sides, and deposited in a receiver — a solid lin-o'-type.

The machine occupies twenty-five square feet of floor space, weighs nearly one ton and is run by a quarter horse-power motor. As high as fourteen thousand ems nonpareil have been set on the Linotype in one hour, the average speed of all operators being about five thousand ems per hour. The cost of the machine, minus late improvements, is $3,000. Double-deck Linotypes are listed at $3,600.

ROGERS TYPOGRAPH.

The Rogers Typograph, invented by John R. Rogers in 1890, was heralded as the successor of all preceding typesetting machines. It produced a slug similar to the Linotype, and being less complicated was thought to be the coming machine. Its career in this country, however, was short-lived. The Mergenthaler Linotype Company secured an injunction

against its manufacture in the United States early in 1891, for infringement of patent, afterward purchasing the United States patents, factory and machines on hand for the sum of $416,000 in order to control the use of the wedge justifier, which had been acquired by the Typograph Company from its inventor, J. W. Schuckers.



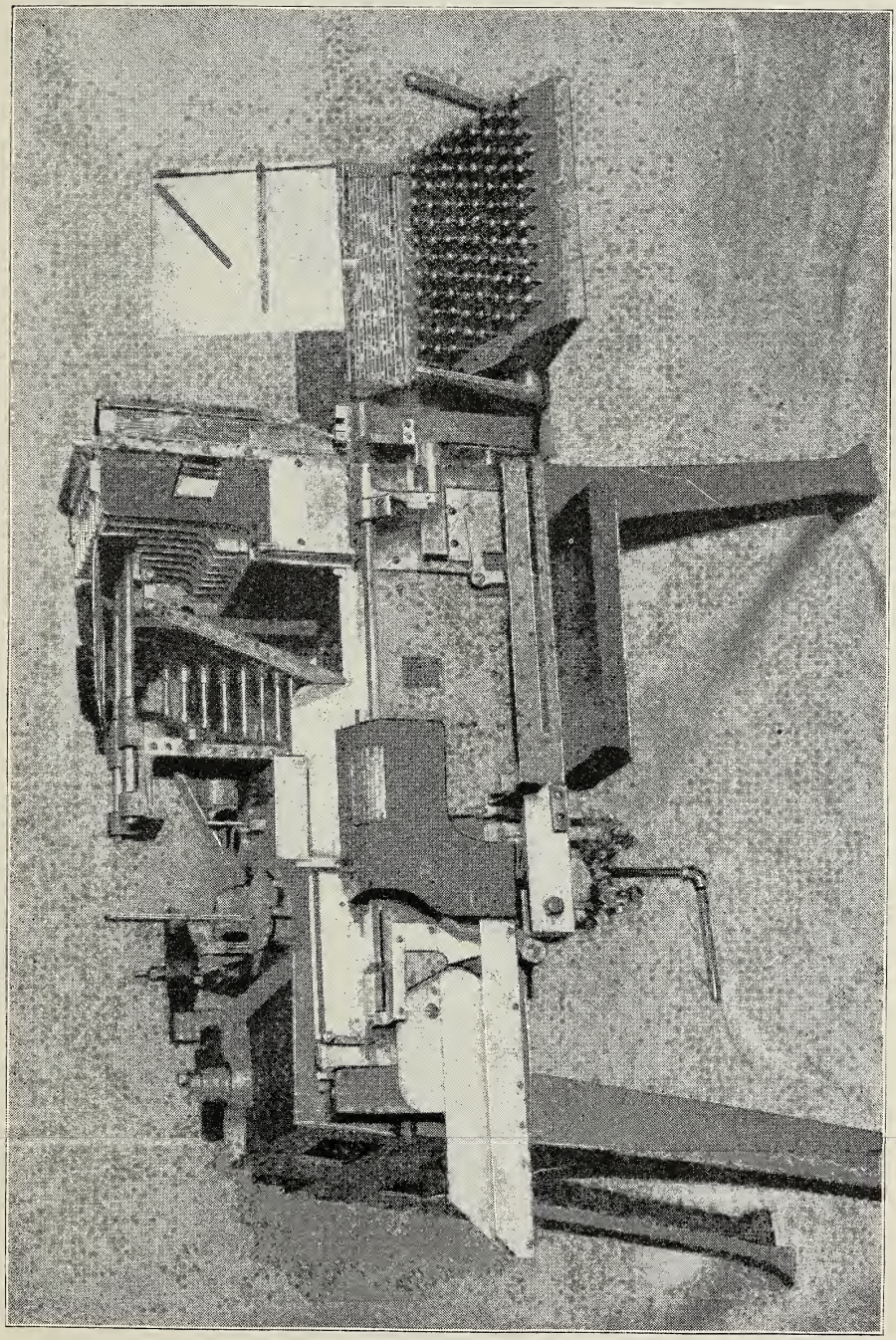
ROGERS TYPOGRAPH.

The Typograph continues to be manufactured in Canada and Europe, however, and hundreds of these machines are in use in those countries. Two styles

of Typograph machines were designed — one device using male dies and making an impression from the line of assembled dies into a soft metal blank, from which a slug or line of type was cast in a secondary machine. The greater number built, however, were equipped with female matrices and the line was cast in the same machine, circular revolving wedges being brought between the words. When the machine was thrown into action these wedges revolved and spread the line to justify it, mold and metal-pot were locked against the matrices and a line of type cast. To distribute the matrices the operator lifted the frame of wires and tilted it backward, the matrices sliding back on the wires to their original places. The machine was driven by motive power, though if desired could be operated manually, the operator by turning a crank causing the justification and casting of the line.

THE MONOLINE.

Another slugcasting machine which came into conflict with the Linotype patents and was consequently barred from the United States was the Monoline machine, invented by W. S. Scudder in 1892. This machine is about one-third the size of the Linotype and is being manufactured in Canada and Germany, where a large number are in daily use. The price in the various countries ranges from $1,000 to $1,500. The Monoline matrices have twelve characters stamped on each bar. The magazine has but eight channels, the matrix bars being about three inches long and varying in thickness according



THE MONOLINE.

to the width of the characters which they bear on their edges. The operation of the keyboard releases a matrix bar, which is allowed to descend to a distance which will permit the matrix of the letter desired to be in alignment with the mold. The matrix travels but four inches in one direction and one inch horizontally, from magazine to assembler, and, after being justified by wedge spacers, is moved in front of the metal-pot and the line is cast. The distribution of the matrices to their eight different compartments in the magazine is the most ingenious of devices. Each matrix bar is provided with a hook on its upper edge, there being eight different lengths of hooks, those matrices bearing the same characters having hooks of the same length. After the cast is made the matrices are all brought to the same level at the bottom, thus bringing the hooks of the matrices to different heights, all those belonging to matrices bearing the same characters being at the same height. Connected to the magazine, one end terminating at the mouth of each channel, are nine pairs of arms, one being for the spacebar. These arms descend, a steel wire on each coming into the path of the matrix line as it is moved along, and as these wires stand at different levels, the hooks of the matrices slip upon the wires which lead to their respective compartments in the magazine, into which they are swept when the arms rise with the matrices suspended from them. From four to five thousand ems per hour is the capacity of the Monoline.

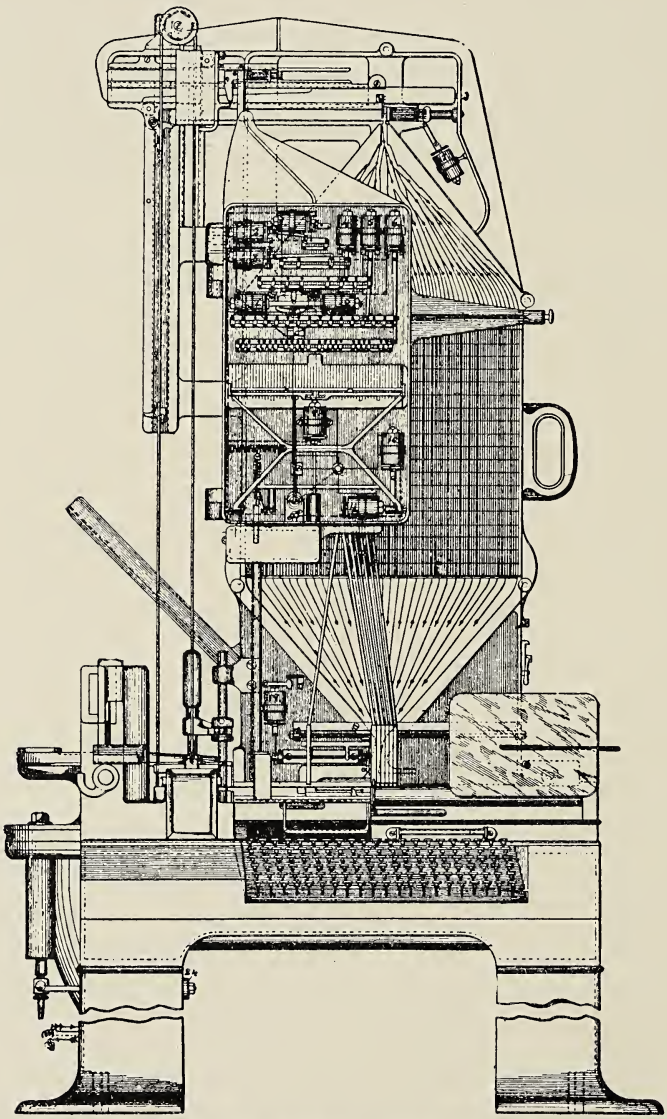
NOVEL SLUG JUSTIFIER.

I. McK. Chase, of Washington, D. C., in 1897 patented a novel method of justifying type-bars or slug lines. His idea was to form the slug with bridges of metal connecting the words in the line and then compress or stretch the slug to the desired length. The novelty lay in the proposition to justify a type-bar after casting it. The fact that metal hard enough to print from possesses little elasticity did not deter this inventor.

BELLOWS ELECTRIC COMPOSITOR.

Benjamin F. Bellows, of Cleveland, Ohio, patented an electrical linecasting apparatus in 1897. Electricity is employed throughout in his device instead of mechanical actions. The magazine holds matrices for 126 different characters, so that small caps. and italics in addition to roman faces may be composed. Besides its electrical features, the novelty in the Bellows Electric Compositor is the method of justifying the matrix line. As each matrix is assembled, its width is telegraphed to a calculating device in the space magazine, which contains solid brass spaces of various thicknesses. A number of tubes are connected at their upper ends to the space magazine, the lower ends of the tubes being assembled between the words in the line by the touch of a word-key. When the line is completed the calculating device is ready to deliver spaces of the required thickness to justify the line through the space tubes, which latter are withdrawn as soon as these spaces are dropped into place. The matrix

line is then presented to the mold and the slug is cast, the matrices and spaces being then lifted to the top of the magazine and distributed. Here another unique device is employed. The matrices



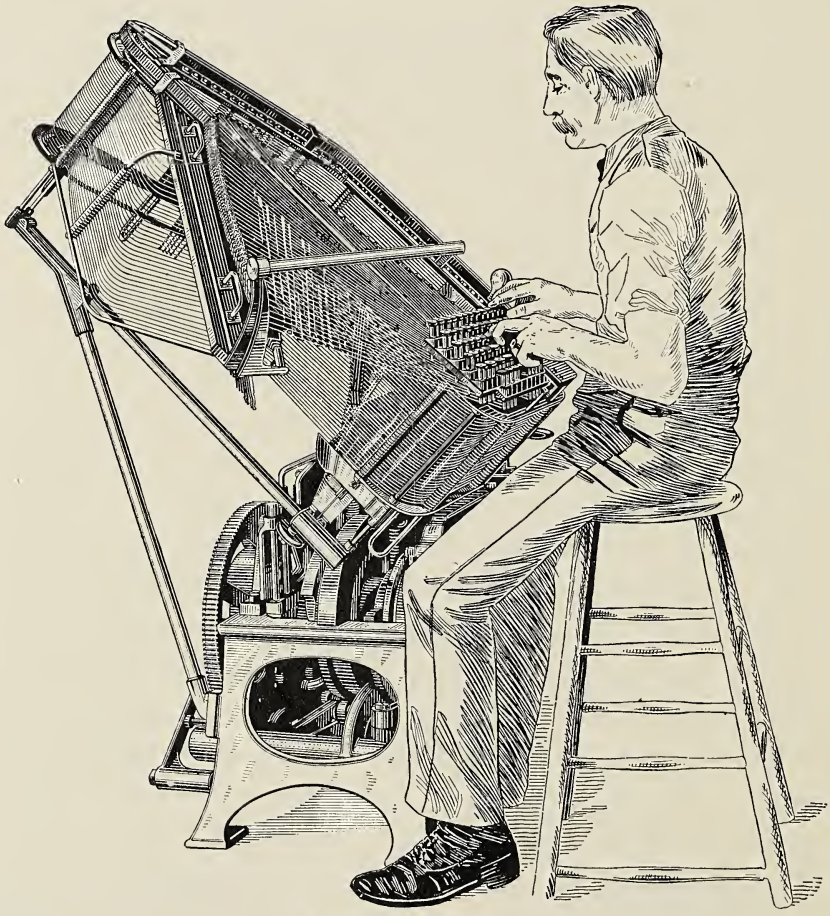
BELLOWS ELECTRIC COMPOSITOR.

have holes drilled through them, no two matrices of different character being drilled alike. Wires connecting with magnets which control switch-gates are presented to each matrix as it reaches the throat of the magazine. By the contact of these wires through the perforations in the matrices the proper magnet is energized, switching open the gate to direct the matrix into its proper channel. Thus each matrix is made to telegraph its own channel open. The machine, complete, weighs about six hundred pounds and can be changed from one size or style of type to another by removing the magazine and substituted another containing the desired matrices.

LINOTYPE JUNIOR.

A direct development of the Rogers Typograph is the Linotype Junior, invented in 1899 and brought out in 1902 by the Mergenthaler Linotype Company. The improvement consisted in making the matrices capable of circulating through the machine instead of using the retrograde distribution of the Typograph, which prohibited composition of the second line until the first line had been cast and the dies distributed. In the Linotype Junior the wires from which the matrices depend are carried in a circular path from the assembling point to the rear of the machine, where the matrices are stored, stopping in their travel before a pot of molten metal, at which point the line is justified by wedges and a slug cast. The entire set of matrices may be lifted out of the machine and another size substituted, the machine

being equipped to set two sizes of type. Its capacity is from three thousand to four thousand ems per hour, and it is sold for $1,500. A small motor furnishes the power. The product of the machine resembles that from the ordinary Linotype machine. The improved form of Junior Linotype is equipped with a standard Linotype keyboard and it possesses several minor improvements.

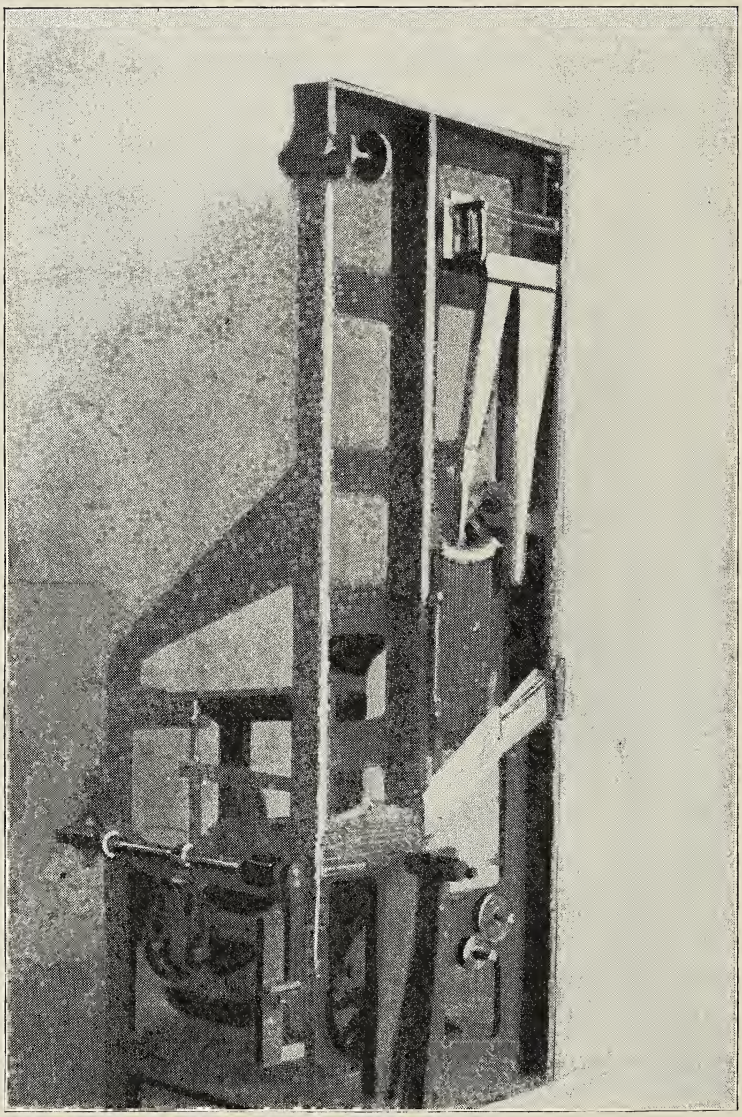


LINOTYPE JUNIOR.

THE BROWN BAROTYPE.

A slugcasting machine combining the good features of several of its predecessors is the Barotype, the invention of H. E. Brown, a newspaper man and practical printer of Sterling, Illinois. This is the latest thing in this class of composing machines and the illustration here shown is that of the experimental machine, taken before the apparatus was completed. It may be said to combine prominent features of Monoline, Typograph, Electric Compositor and Linotype machines. The matrices each carry ten characters stamped on their edges, there being ten groups of matrices, thus providing for the 100 characters on the keyboard. The matrices are stored on inclined rails, from which they suspend by two hooks or shoulders, one group above another. A delivery channel leads from each group, and an escapement electrically operated releases the matrices one at a time. In order to overcome the loss of time otherwise unavoidable in assembling the matrices from their high storage channels, one matrix from each group is always retained at the bottom of each delivery tube, and it is this matrix which is assembled when a key on the keyboard is struck by the operator. The operation of the keyboard closes electrical circuits arranged to simultaneously operate the escapement at the bottom of the channel and the escapement holding the matrices in the storage channel, so the matrix assembled from the bottom of the channel is instantly replaced by another from above. Thus, in assembling, no character has more than three inches of travel from magazine to its place in the line,

sliding on rails. The operation of the keyboard also throws a switch to guide the matrix at the proper level in the assembler, so as to align the desired character on the edge of the matrix.



THE BROWN BAROTYPE.

As in the Electric Compositor, tubes are assembled between the words, the upper ends of which are connected to the justifying space magazines. As each matrix is on the unit system and a calculating device computes the number of units and number of spaces in each line, the space magazine is ready, when the line is completed and the operator touches the line key, to deliver through the tubes solid spaces of the exact width to justify the line. Seven widths of spaces are employed.

The justified line now moves before the metal-pot shown on the left, where the matrices, which are slid on to aligning rails to present the proper matrix to the mold, are clamped and aligned, and a slug cast. A peculiarity of slugs produced by the Barotype is the fact that they are smooth and without the distinguishing ribs of the Linotype slug. The mold swings on the end of a lever, and after the slug is cast the mold is rocked and presented to the ejector, which deposits the slug on end in a receiver, as in the Linotype.

The Barotype matrices have distributing teeth similar to the Linotype, and are elevated to the top of the machine after the slug is cast and carried along the combination distributing bar until they reach their storage chambers. The spaces likewise are delivered to their separate storage chambers. It is not necessary to fill out quad lines, as the machine is so arranged that, with lines of this character, a block fills the gap before the mold.

Perforated Paper Controllers

The Jacquard system of controlling mechanism by means of a perforated pattern has been successfully applied to typesetting machines, and has also been adopted to control the actions of typecasting machines and direct-printing mechanisms. Alexander Mackie, in England, and J. E. Munson, in America, were first to apply the Jacquard system to compose individual type, while Lanston was the first to adapt it to typemaking machines. It has recently been applied to typewriting machines which print directly on transfer paper, this being transferred to zinc or similar material to produce a plate for surface printing.

LANSTON MONOTYPE.

Tolbert Lanston, of Washington, D. C., was the first of modern inventors to adapt the perforated tape system to control the mechanism of a typemaking machine and his invention inaugurated a new class of composing machines. In his first apparatus of 1885 he proposed to make the type by compression. The perforated tapes, of which he employed two, caused a strip of type metal to be fed into a compression box and the proper die to be centered above it, a section of the type metal cut off and compressed to form the

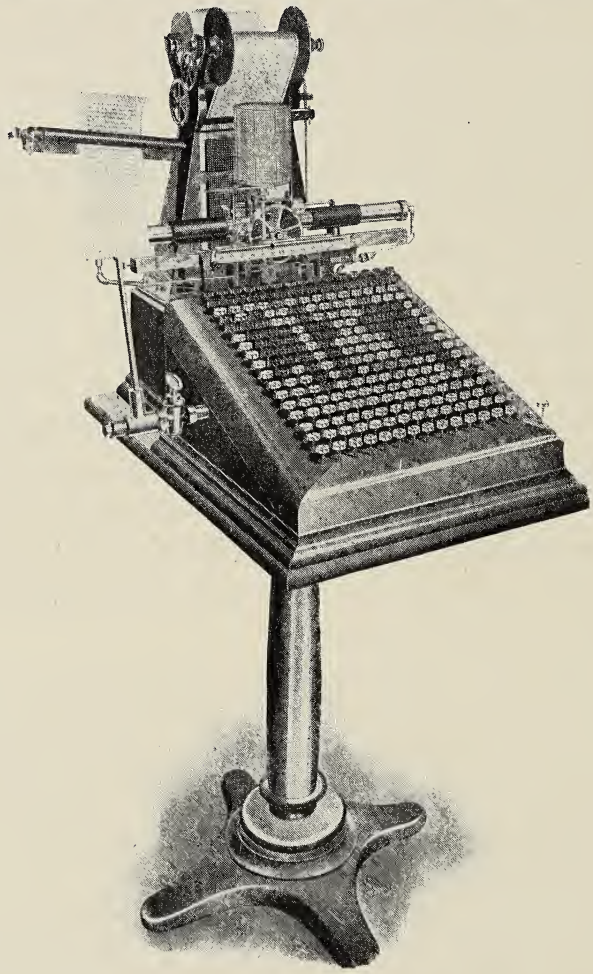
type, which was then ejected on to the galley, the entire operation of the typemaking machine being automatic. Justification was provided for on a novel principle. A scale indicated to the operator of the perforating mechanism on completion of a line the amount of space yet unfilled and the percentage which this bore to the filled space, he thereupon striking certain keys to cause perforations to be made at the end of the line. The tape was fed backward through the automatic typemaking machine and these last perforations caused the body of each letter in the line, or, if desired, only the spaces therein, to be increased above the normal such a percentage as to produce a line of justified type. In this machine electromagnets were employed to control the mechanism.

In 1890 Lanston proposed to cast the type instead of forming it by compression, and employed a mold wheel containing several adjustable molds into which the metal was injected in rotation as the dies were centered over the molds.

In 1897 the Lanston Monotype as it is at present constructed was invented and immediately went into use in a large number of printing-offices which felt the need of a substitute for hand composition more adaptable to the requirements of book and tabular matter than slug machines.

The Lanston Monotype casts single type in justified lines, which, after being used, are remelted. The keyboard is separate from the casting device, and utilizes compressed air to cause perforations in the paper tape as the keyboard is operated. There are 256 keys on the Monotype keyboard, 225 of them

being character keys, providing for small caps and italics as well as body letter, and thirty keys for justifying purposes, and one for restoring the parts after completion of the line. The keys are arranged in



MONOTYPE KEYBOARD.

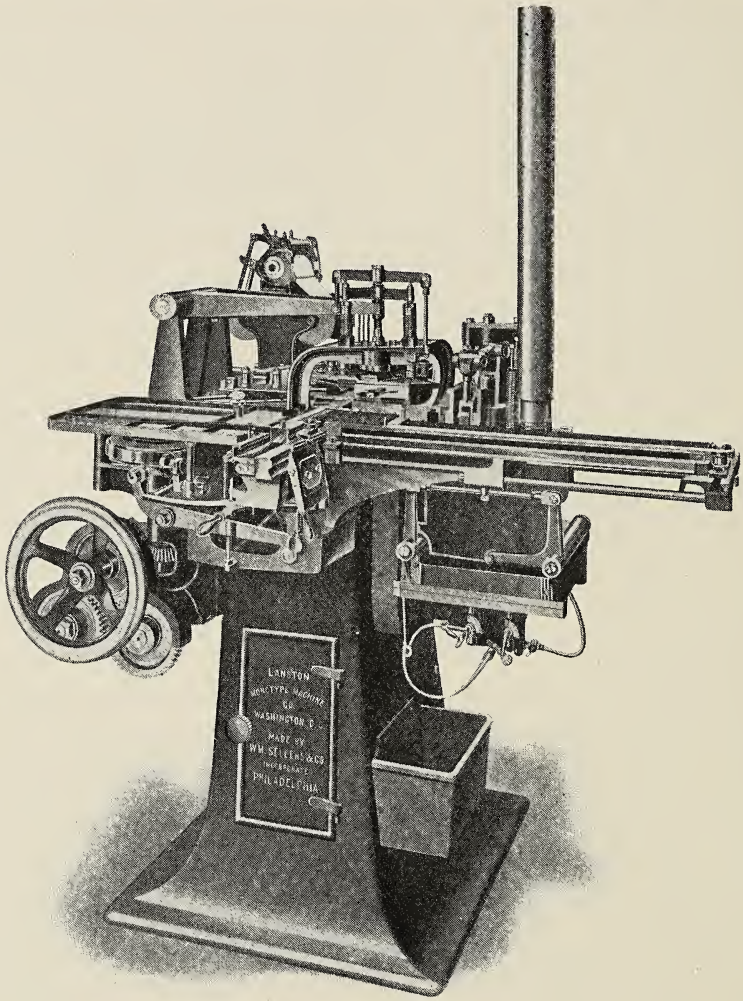
fifteen vertical rows with seventeen keys in each row. Each key is in fact a valve, which when struck allows compressed air to escape into the proper chamber in

the keyboard and causes two punches to perforate a pair of holes in a roll of paper ribbon mounted above the keyboard. There are twenty-four punches ranged side by side below the roll of paper, and it is the holes which these punches make that represents the work done by the keyboard operator. The justification keys are the two upper rows on the keyboard, and are numbered each from 1 to 15. Justification is based on the unit system, each character representing a certain number of units of an arbitrary standard, a calculating device adding the total number of units in each line and indicating on a dial the exact number of units the line lacks of complete justification.

To set any size type it is only necessary to place upon its spindle on the keyboard a cylindrical paper frame marked with the desired size of type. This cylinder is called the justifying scale, and is covered with small squares, each square containing two figures. When within four ems of the end of a line the justifying scale begins to revolve at each stroke of the keys, the pointer on the scale meanwhile ascending a step each time the space-key is operated. The pair of figures on the justifying scale which the pointer indicates when the line is finished, informs the operator which justifying keys to strike to complete the justification of the line. When the "take" is completed, the paper is torn off below the last perforations and transferred to the casting machine, where the actual production of the type takes place.

The caster machine occupies a floor space of 3 by 4 feet, and is about four feet over all in height, and

weighs about fifteen hundred pounds. It is run by a one-half horse-power motor, and is piped for air, water and gas. The compressed air is used for setting



MONOTYPE CASTER.

the stops in the machine, which present the proper matrix to the mold, the water to keep the mold cool, and the gas to heat the metal-pot. The central fea-

ture of the caster is the die case, 4 by 4 inches in size, containing 225 cubes of copper, which are the type matrices. This die case moves backward and forward in a compound slide, controlled by a number of levers, and centers the proper letter over a mold, below which is placed the nozzle of the metal-pot. The mold is fixed as to body, but has a steel blade, which is movable in a slot, and which regulates the width or set of the type to be cast. This blade is controlled by two steel wedges, a third wedge controlling the blade when space types are to be cast. The type is cast backward in the casting machine. The last letter perforated in the keyboard is the first letter cast in the caster. The last perforations made in the roll being the justifying holes, the justifier wedge is first set so that all the spaces in that line will be cast of the same thickness and of proper size to accurately justify the line. As the paper unreels, each pair of perforations uncovers two apertures, through which the air rushes, passing through corresponding channels to the pin blocks, which control the positioning of the die case. These pin blocks lie at right angles with the mold, and each is studded with fifteen pins, which normally lie flush with the surface of the blocks. The air being admitted beneath the proper pins, it raises one pin in each block, and the levers controlling the die case are caught by these pins, and thus present the proper matrix to the mold, which is instantly adjusted to the width of the matrix presented. The die case being centered over the mold and seated down on it firmly, the plunger is operated and the type cast, trimmed on the bot-

tom and ejected into a runway, the whole line when completed being transferred to the galley.

To change style of type on the Monotype it is necessary to change the matrix case only; to change the body on which the type is cast, the mold and normal space wedges must be changed, about fifteen minutes' work. An improved attachment for the Monotype permits job type sorts to be cast in this machine.

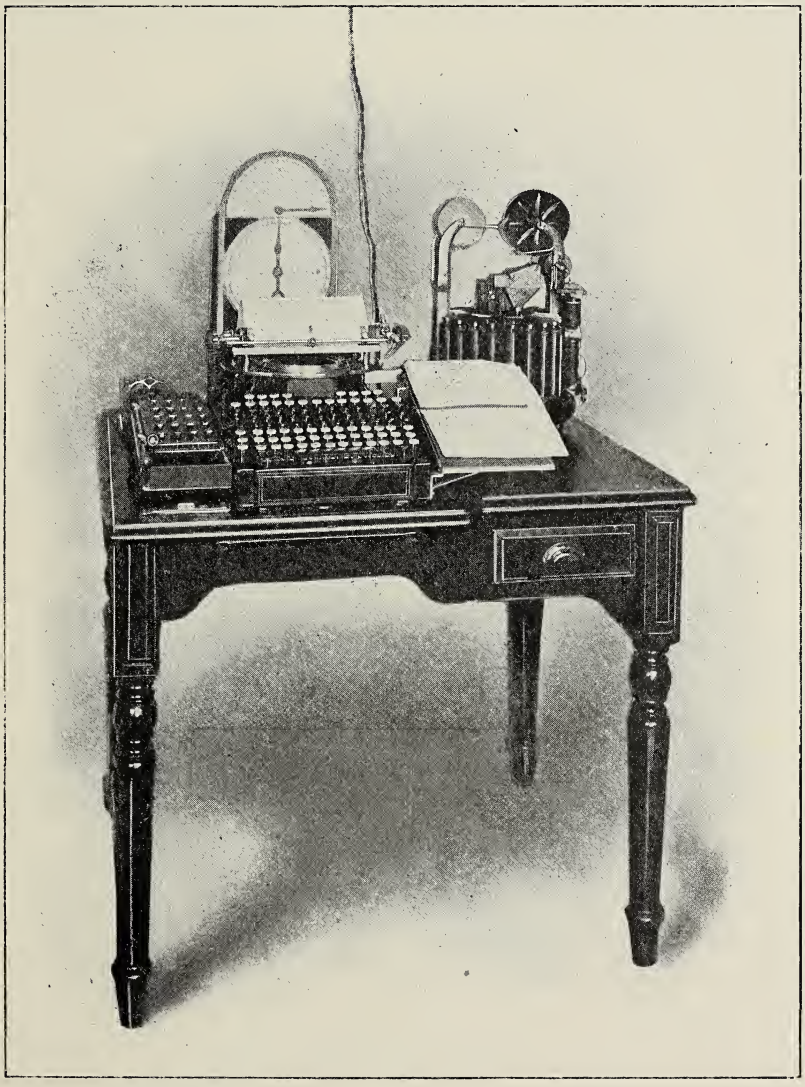
The average output at the keyboard is four thousand ems per hour, while two casters will ordinarily handle the product of three keyboards. Keyboards cost $500 each and casters $2,500.

GOODSON GRAPHOTYPE.

The Goodson Graphotype, invented by George A. Goodson, of Minneapolis, Minnesota, in 1893, is another of the paper-perforating, typecasting class of machines. It accomplishes its work by electrically controlled devices, its product being similar to the Monotype.

An ordinary typewriter is connected electrically to a perforating device, which produces a perforated symbol of the matter composed on the typewriter keyboard, the typewriter producing its ordinary record of the matter. Calculating devices furnish the scheme of justification in a manner similar to the Monotype. The paper ribbon is fed through the casting machine, which weighs but three hundred pounds, and pins which drop through the perforations in the tape fall into wells of mercury and close electrical circuits which control the casting of the proper

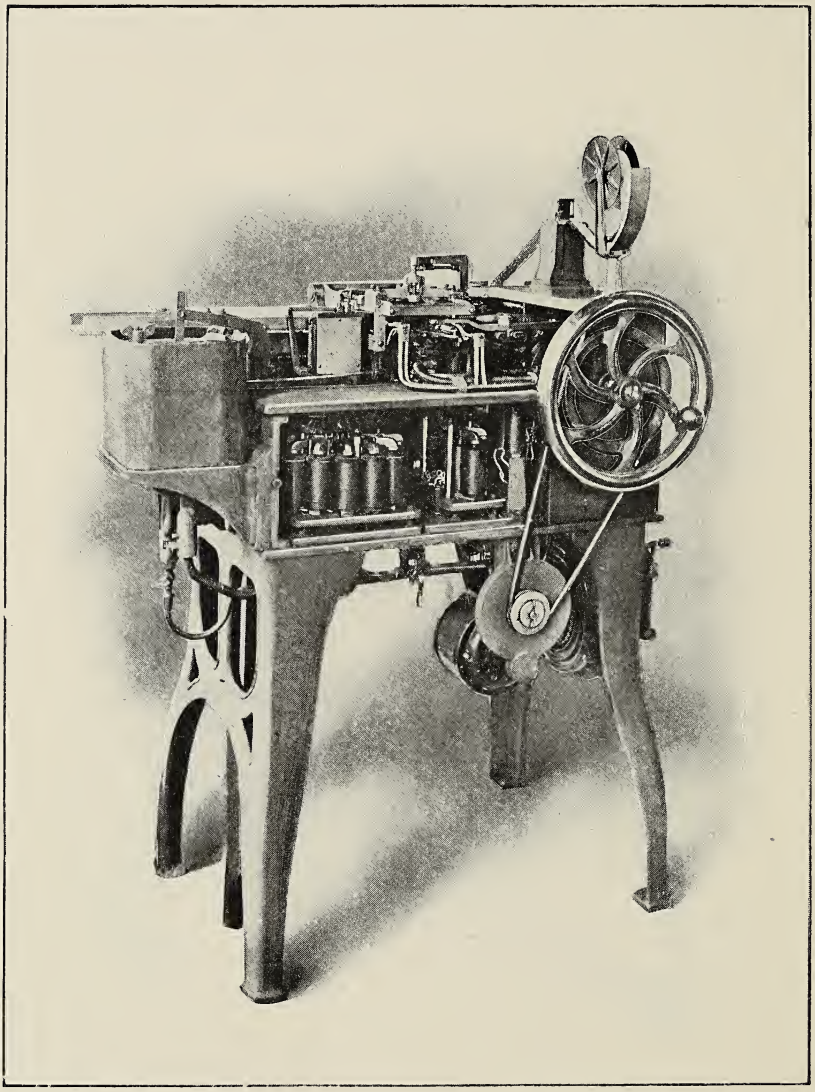
type. Its speed is upward of six thousand ems per hour, high speed being made possible on account of the method of casting, the metal being conducted through a long tube at a low temperature and



GOODSON GRAPHOTYPE KEYBOARD.

electrically heated just before being injected into the mold.

A peculiarity of type cast by the Goodson process is the fact that it is hollow, this being accomplished



GOODSON GRAPHOTYPE.

by applying suction to the mold immediately after the cast is made, thus leaving a hard shell instead of a solid type. Any size of type can be cast by the Goodson Graphotype and any length of line up to thirty ems pica. A few of the machines are in use in New York city.

BEALS' APPARATUS.

E. V. Beals proposed, in 1893, to control by a perforated pattern the impressing of dies in a soft matrix material, from which slugs could subsequently be cast.

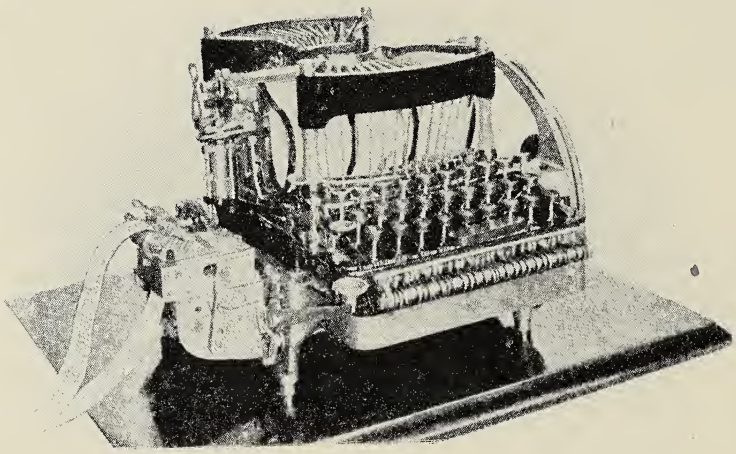
THE TACHYTYPE.

Frank A. Johnson patented, in 1897, a typecasting machine controlled by perforations formed in a paper roll, which he called the Tachytype. The machine has not been constructed.

THE ELECTROTYPOGRAPH.

Another form of type casting and setting machine was invented by C. Meray-Horvath, of Buda-Pesth, Austria-Hungary, in 1897. It is called the Electrotypograph and uses paper bands to indicate the letter, sign, or space to be cast. The bands are perforated by a special machine somewhat similar in outward appearance and size to a typewriter, and to which may be attached a "Teletypograph"—an apparatus which causes electric duplication of the perforations at a distance and thus permits simultaneous composition of the indicated text of an article in different places.

Three separate machines are used by this system. The first is the typewriter and band perforator. This machine produces at one operation the copy in every respect similar to that made by an ordinary typewriter, and at the same time makes the holes which later serve to control the movements of the typecasting machine. The power necessary to work the perforator is less than that used on a pedal sew-



ELECTROTYPOGRAPH KEYBOARD.

ing-machine and can be produced by similar pedals or by a small motor. The keyboard has thirty-three keys, divided into three rows of eleven each, but these only represent one-third of the movements of the subsequent machine, because each key is capable of producing three different results—lower-case letters, capitals, and signs not included in the alphabet (quotes, punctuations, parentheses, hyphens, etc.). Thus the same key produces the cap. "B," lower-case "b" and exclamation "!". When the operator wishes

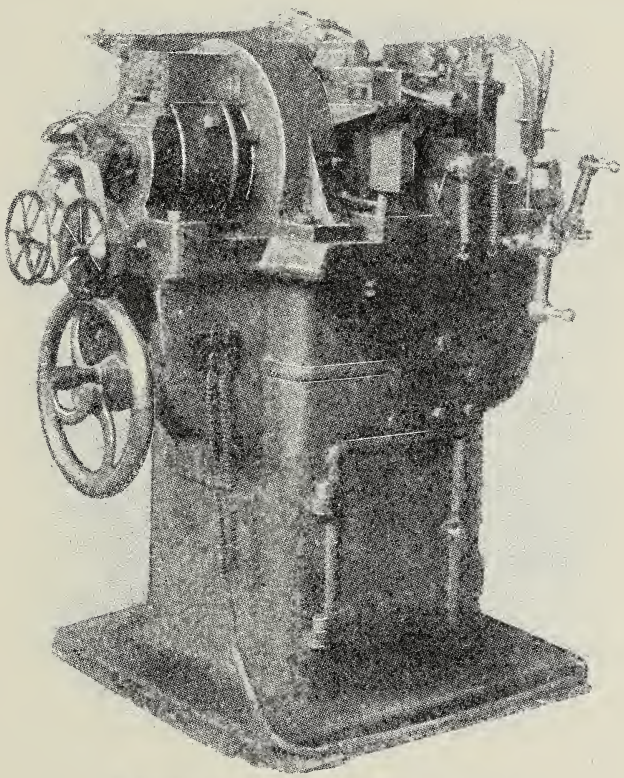
to obtain the "b" he presses on the key which bears that indication with a finger of the right hand; if he wishes to get "B" also he touches with a finger of the left hand a special lever, which produces a movement that will later on result in the casting of a capital letter; if he needs the note of exclamation (!) he presses with the right hand the same key and at the same time depresses with a finger of the left hand another lever, and these movements will thus indicate the required character. In response to each touch on the keys, a letter similar to that produced by the typewriter is printed on the paper band in addition to the perforation of the paper. The copy thus produced can be read by the proofreader and errors rectified in the perforation, with the result that the matter cast later on will be free from errors.

The working of the mechanism for justification is not the least curious part of the machine. This was the invention of Coloman Rozar, of Nuremberg, Germany. A small disk, graduated in millimeters, is mounted on the machine, on which a stop is fixed to indicate the measure of the matter to be set. For example, the machine is set to 100 millimeters (about 22 picas); the letters and signs are all graduated to tenths of millimeters, while the spaces are capable of increase or diminution by units or tenths of millimeters. Each time a letter, space or sign is struck on the keyboard, a small tongue having the thickness of the required character engages in a channel of the cylinder beneath the machine and makes it turn a corresponding distance. This displacement is transmitted to a finger on the graduated disk, which

advances accordingly, and the point opposite which the indicator stops shows the sum of the thickness of all the letters in the line. The justifier is so arranged that it can be set within five millimeters (about thirteen points) either way. That is, the measure being 100 millimeters, the line may be cut at any point between 95 and 105 millimeters. At 95 millimeters a bell rings and the operator begins to look for a satisfactory place to terminate his line, and having found it, justifies the whole line at once by simply touching the justifying key. By this movement the machine divides up the space automatically between the words. This result is obtained by the perforation of the paper band in a special manner. For instance, if the number of one-tenths of millimeter units to be added or subtracted is divisible by the number of spaces in the line, as when there are twelve one-tenth millimeters to add and six spaces in the line, the machine will, upon pressing the key, add two one-tenth millimeter units to each space; if the amount should be fifteen units to divide between six spaces, the machine will add three one-tenth millimeter units to the first three spaces and two units to the other three. This result is obtained by a calculatory machine, too complicated to be explained.

The casting machine is very solidly constructed, and measures about 36 by 32 inches, and weighs in the neighborhood of three thousand pounds; it is mounted on a square base through which the driving shaft runs. This shaft carries the pulley outside the base, and inside the pedestal it is fitted with a variety of cams, cogs and other mechanism which

serve to operate the different devices in the machine. At the right-hand upper part in our illustration is the metal-pot, heated by gas, and the piston which drives the melted metal into the mold; on the left is the spool which carries the perforated paper band and the mechanism controlled thereby. In the middle is the



ELECTROTYPOGRAPH CASTING MACHINE.

die case containing all the matrices to correspond with perforations in the paper band. This band passes over a small copper cylinder and is kept in close contact with it by two rubber rollers, and regulated by the guide holes in the band. Seven fingers

corresponding with the seven rows of holes line up the band as it passes beneath them. Each time a perforation occurs beneath one of these fingers it comes in contact with the copper cylinder and transmits an electric current, the passage of which determines the position of the die case and the thickness of the body of the letter to be cast. As each lever on the keyboard controls three characters, so each matrix carries three surfaces, each bearing the impress of a different letter or sign, one of which is presented to the mouth of the mold in response to the electric current passing from the copper cylinder. As soon as the letter is cast it is seized by a claw, trimmed on all sides, and when finished is transferred vertically into a channel which may be compared to the composing stick. The casting of the spaces used in justifying the line is a more complicated process. The paper band, which is started through the machine from the end, instead of beginning, presents the space indications first, and these are determined for the line before any letters are cast, and at each electric contact a space of the indicated thickness is cast as needed. As each line is cast and justified it is transferred to a galley. The size of the body of the matter is regulated in a manner analogous to that in use in the ordinary type-casting machine. The matrices or dies may be changed at will and this takes about ten minutes, if only the face is to be altered; but if the body also has to be changed, about thirty minutes will be necessary to rearrange the machine. The metal is maintained at an even temperature by means of a

mercurial regulator which keeps the heat uniform all the time the machine is running. This machine casts at the rate of from 4,500 to 5,000 characters an hour. The paper band can be run through the machines over and over again to produce duplications of the matter set.

The Teletypograph constitutes an absolutely original invention and has for its aim the perforation at a distance of a second paper band identical in every respect with that produced by the original operator at the first typewriting and perforating machine. It is composed of three devices: First, the transmitter, or reader of the band, which passes beneath a series of small levers, one of which, at each perforation, transmits to a telegraph wire, a current, positive or negative; second, the receiver, situated at the other end of the line (it may be in another city miles away); third, the perforator, which following the indications of the receiver, perforates the band in a manner identical with that of the band from which the current is transmitted. All these machines somewhat resemble the Baudot telegraphic apparatus, but differ from it in some particulars. By the Teletypograph a speed of 180 characters a minute can be attained, which is about double that of the typecasting machine, while if the triple system of telegraphy is used on the wire, about 540 letters per minute can be sent and received (32,400 per hour), which would be sufficient to keep six or seven Meray-Rozar typecasting machines supplied with bands. A factory has been established in Paris and machines are being constructed for the daily Parisian newspaper, "Temps."

Transfer Machines

An attempt to substitute lithography for setting type was made by Pierre Flamm in 1864, his machine being designed to print the characters as the keys were operated on to a metal plate and print direct from the surface by the lithographic method. This idea has allured other inventors, an example of a machine of this class being that of Charles T. Moore, who as early as 1877 attempted to construct a machine on these lines. It was while experimenting with this apparatus that Ottmar Mergenthaler made his invention of the Linotype.

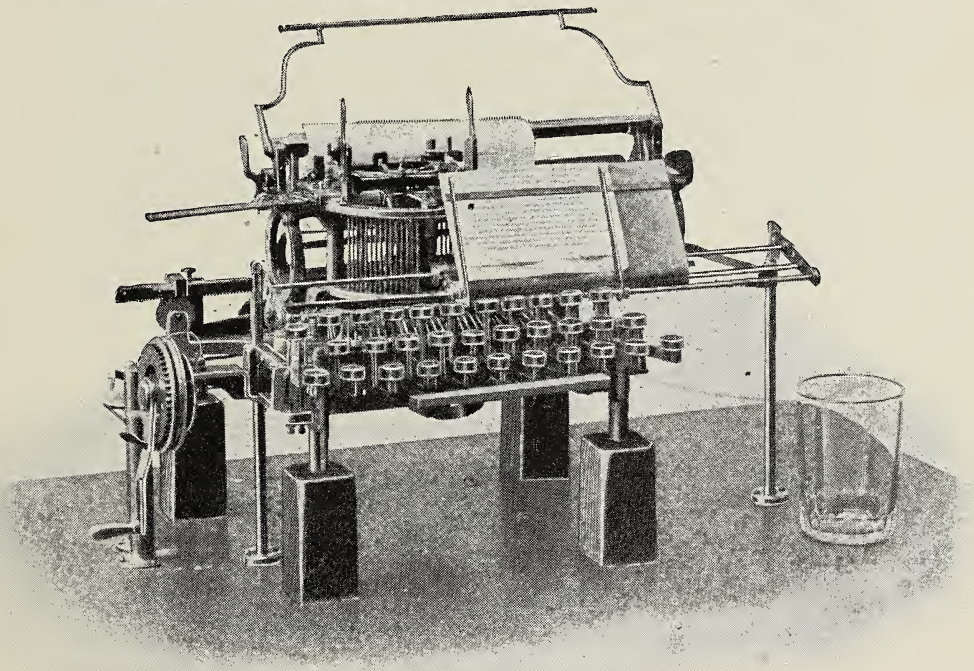
THE PLANOGRAPH.

The Planograph machine, recently announced from Washington, is understood to be a modern development of Moore's patents. In this machine, instead of causing the letters to be printed directly by keyboard manipulation, the first step in the process consists in perforating a strip of paper on the lines followed by the Lanston machine. The perforated strip is then fed through the printing apparatus which prints the characters on chemicalized paper, the lines being properly justified by a system of computation as in machines of the Lanston and Goodson class. The third step consists in transfer-

ring the printed characters to the metal plate, which is then printed from directly. Justification in this apparatus is satisfactorily accomplished, patching of the paper being necessary, however, in making corrections.

SEARS DIRECT PRINTER.

Charles Sears, of Cleveland, Ohio, invented a typewriter carriage which steps at each stroke of the keys only the width of the letter printed, thus permitting typographic results with this special typewriter. This invention forms the basis of the Direct Printer. The original copy is produced on a differential-feed



SEARS DIRECT PRINTER.

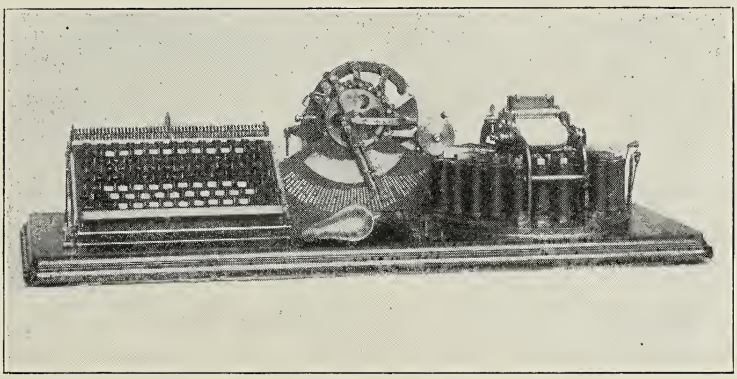
typewriter instead of the ordinary typewriter. The proof is then read and corrected in the usual manner (making perfect copy), and is then given to the operator of the Direct Printer — a similar machine but equipped with guides and indicators between which the typewritten copy is placed. As the printing of the matter progresses the operator notes which lines need spacing above or below the normal, he increasing or decreasing the spacing as he proceeds as needed to produce lines filled to the full width of the measure being composed.

Lithographic transferring paper is used in this machine, and after the "take" is completed and corrections made on a separate piece of lithographic transfer paper, cut out and placed over the error and punched fast with a steel point, the printed sheet is placed, face downward, upon a plate of aluminum, zinc or steel, and the ink transferred to the metal plate. The plate is then treated lithographically, and is then ready to be printed from. This machine has recently been rechristened the American Direct Printer.

THE LITHOTYPE.

In 1904 Walter S. Timmis, of Brooklyn, New York, announced his invention of a paper-perforating and direct-printing mechanism. It is called the Lithotype and comprises two separate machines, one which perforates a strip of paper, and the other which prints the transfer sheet under control of the perforated tape. The first machine is provided with a keyboard of a hundred keys. On depressing a key two electrical contacts are made which close the cir-

cuits of two of the electromagnets in the perforator mechanism shown at the right in our illustration. The two magnets thus actuated attract their respective armatures, which operate corresponding punches to perforate the paper. The perforator mechanism comprises twenty electromagnets which may be operated in a hundred different combinations to correspond with the keys of the keyboard. After each combination is perforated the paper strip is moved forward a unit's distance, presenting a fresh surface to the next combination.



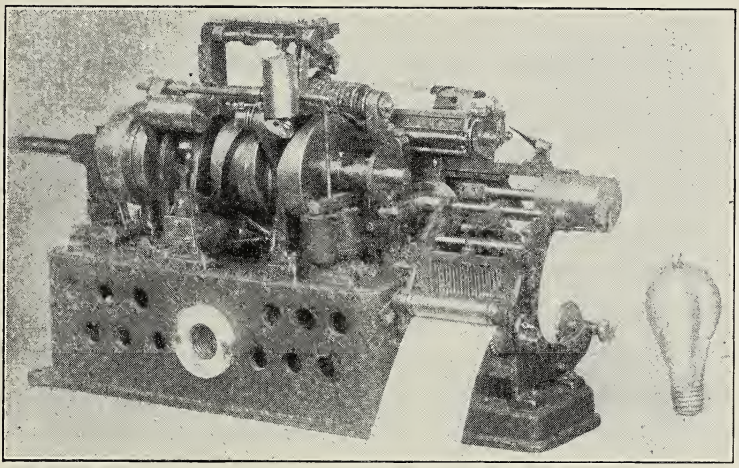
THE LITHOTYPE — PERFORATING MECHANISM.

The mechanism which produces the justification is shown in the illustration between the perforator and keyboard. Normally this is set to allow for a nine-unit space between each word — a space equivalent to one and a half ems, and obviously much greater than would ordinarily be required. In other words, a certain portion of the length of the line is reserved for spacing. This reserved portion varies, of course, with the number of words in the line, being

equal to nine-units times the number of spaces required. As the perforation of the strip continues, in time a point will be reached where the aggregate length of the words in the line exceeds this variable spacing reserve, and thereupon the selector arm begins to move. The selector arm, which may be seen in the center of the illustration, moves over two series of contacts, one representing units of space and the other tenths of units. When the reserve begins to be encroached upon, a calculating device determines the width of each encroaching character struck and deducts this from the normal reserve. At the same time the selector arm is automatically swung about until it lies over the contact representing the quotient of the remaining reserve divided by the number of spaces required in the line. As soon as the selector arm begins to move, the operator adds to his line sufficient characters to complete his syllable or word, and then touches the line-key, which produces a line-closing perforation in the paper strip. As the last character in the line is struck, the selector arm is moved over the contacts representing the amount of space which must be used between each word to completely fill out the line, and when the line-key is struck a switch is closed connecting the justifier contacts with the electric circuit and the selector arm is pressed against these contacts, which cause a corresponding combination of perforations to be punched in the paper strip.

After the desired matter has been perforated and recorded upon the tape, the latter is passed through the second machine. In this machine two series of

contact fingers bear against opposite faces of the tape, and the fingers make contact with each other through the perforations as the tape travels between them. The tape is passed backward through this machine; that is, the end of the line is first to pass between the contact fingers. Consequently, the first contact made is that of the justifier. The justifier contacts close the electric circuit to the justifying mechanism, setting



THE LITHOTYPE — PRINTING MECHANISM.

the latter to give the proper spaces in the line. The characters are printed on a transfer sheet of paper, by means of a type sleeve, which is given two movements, one a rotary movement and the other a horizontal axial movement. When a character contact is made, the type sleeve, starting from normal, is operated by two springs, one tending to move the sleeve through a semi-rotation and the other to draw it axially from the right to the extreme left. A series of ten pins is arranged at the left end of the type

roll, and a similar series is arranged at the right end, the former serving, when raised, to limit the axial movement and the other co-operating with pins on the axis to limit the rotary movement. As stated above, each character is represented by two perforations on the tape; one of these makes contact with a corresponding pin at the right and the other with a corresponding pin at the left. Now, if, for example, the eighth pin at the right were raised and the third at the left, the sleeve would rotate three character spaces and slide axially eight character spaces, bringing the predetermined character on the sleeve in line with the printing hammer of the machine. The latter is thereupon actuated to strike the paper against the sleeve and make the required impression. This done, the type sleeve is restored to normal position by two cams and is ready for the next operation. At the same time the carriage which carries the transfer-paper is moved laterally a distance corresponding with the width of the character just impressed. As soon as a word is completed, a space perforation is encountered on the tape which causes the carriage to move the distance predetermined by the justifier. And herein lies another very ingenious little mechanism. The carriage moves only in even multiples of a unit, whereas the justifying mechanism is measured in tenths of units. For example, a space of 3.4 units might be required between each word. In this case the first space would measure three units, and an accumulator device would retain the fraction of unit space. The next space would again be three units and .8 would be retained in the accumulator. The third

space, however, would measure four units and .2 would be retained in the accumulator. Thus, the operation would continue, the accumulator retaining the fractions of space until they accumulated to an entire unit, when that unit would be applied to move the carriage an extra unit of space. At the end of a line the accumulator is restored to normal, the carriage is returned by the line trip and moved up one space for the next line, and the spacing mechanism is reset for the new line by the new justifier combination of perforations. These operations though seemingly slow are nevertheless very rapid. The machine illustrated has been operated at 10,000 ems per hour, or twice the speed at which the average operator manipulates a keyboard. Thus, the transfer machine can handle the output of two perforator machines. Mistakes of the operator can be corrected by pasting strips of paper with the corrections thereon over the faulty matter on the transfer-paper. In the Lithotype, fonts may be changed simply by slipping a new type wheel on the printer.

The sheets of transfer-paper containing the printed, set-up copy are arranged upon a board to properly make up the form. This is then turned over upon an aluminum plate lying on the bed of a transfer press, where it is subjected to pressure. When the transfer-paper is removed from the aluminum plate the ink characters are left upon the surface of the aluminum. This sheet is "rolled up" a few times, swabbed over with an acid solution which fixes the design and is then capable of producing an unlimited number of copies.

Other Methods

It is unlikely any radical departure from present methods of composing type will be made in the near future. A machine combining the good points of all existing machines would be a wonder and find a fallow field, notwithstanding the large number of typesetting machines already in use in all parts of the world.

TYPESETTING BY PHOTOGRAPHY.

W. Friese-Greene, of London, England, proposed in 1898 to do away altogether with type and reproduce the characters directly by photography and etching. The letters were placed on strips, the whole alphabet arranged one above the other in the order of the width of the letters. As the keyboard was touched the corresponding letters were assembled and the letters of the line were thereafter presented before a camera which automatically operated and photographed the characters on the plate. It was proposed to use large letters and reduce to the size desired when photographing.

Patents on Composing Machines

The following list of patents granted on type-setting machines, both in England and the United States, since the earliest record — 1822 — down to date, is believed to be accurate and as complete as careful revision could make it. The patents have been classified under headings, according to the nature of the invention, the classifications being those of the author and not necessarily following those of the Patent Office.

Letters patent of the United States are granted inventors for any new and useful improvement in any art, machine, manufacture or composition of matter. United States patents run for a term of seventeen years, dating from the time of issuance of the patent, and grant to the inventor or his assigns the sole right to make, use or sell the thing patented. United States patents are granted only after an exhaustive examination of the records of all countries and a complete search as to novelty. The legal government fees are $15 upon filing an application for a patent and $20 upon issuance. Full information as to procedure can be had free of charge from the Commissioner of Patents. Persons wishing to inform themselves as to the state of the art in any line of inventions can best do so by purchasing printed copies of the specifications and drawings of the patents in the sub-class containing

the invention, the number and the cost of which will be given on application to the Commissioner.

For convenience, patents are classified by the Patent Office into arbitrary groups and subdivided under a number of headings. Single copies of patents may be obtained at 5 cents each. If ordered by sub-classes, 3 cents each; by classes, 2 cents each; for entire set of patents issued, in one order, 1 cent each. Postage stamps are not accepted in payment.

As only one hundred copies of each patent are printed, the supply of many patents has been exhausted. In some instances additional copies are printed when, in the discretion of the Commissioner of Patents, this is necessary, and in this event an extra charge is sometimes made for copies.

Orders for copies of patents should give the number and date of the patent and the name of the inventor. Orders for patents by classes or sub-classes should give the number of same as well as title of class or sub-class. If desired, by depositing an amount from $5 upward with the Commissioner of Patents, copies of all future patents issued in any class or sub-class will be mailed weekly as issued, at 5 cents each, until sum is exhausted. For convenience in ordering single copies of patents, coupons may be purchased in packages containing twenty coupons at $1 per package, or in books containing one hundred coupons with stubs, bound, at $5 per book.

Typesetting machine patents are found in Division XVII of the United States Patent Office under

three classes — Nos. 199, Linotyping; 198, Matrix-making; 101, Printing. In this division type-writing machines are also found. The sub-classes of these classes and the number of patents in each sub-class at the date of last compilation, January 1, 1902, are given in the following tables:

Class 199—Linotyping.

Sub-class No.		Number of Patents
2.	Linotypes	15
3.	Linotype-making	12
4.	Justifying devices	19
5.	Plural-bar machines	10
6.	Single-bar machines	18
7.	Circulating machines	93
8.	Guide machines	16
9.	Machine attachments	9
10.	Miscellaneous machines	2
11.	Rotary machines	8
12.	Matrices	32
13.	Molds and cutters	54
14.	Brushing devices	11
15.	Melting-pots	9
16.	Justifying mechanisms	18

Class 198—Matrix-making.

1.	Bar	12
2.	Dies	17
3.	Miscellaneous	18
4.	Reciprocating die-carrier, electrical	35
5.	Reciprocating die-carrier, mechanical	19
6.	Rotary die-carrier	44
7.	Matrices and materials	117

Sub-class No.		Number of Patents
130.	Setting and distributing	26
203.	Distributing	13
198.	Feeler—selector	37
190.	Keyboard	10
191.	Type arrangers	29
192.	Type line separators	5
193.	Ward selector	17
194.	Leading and unleading	5
195.	Setting	13
196.	Conveyor-feed	58
197.	Gravity-feed	47
198.	Hand supply	9
199.	Justifiers	32
200.	Making and setting	28
201.	Type channels	25
150.	Type machines	29

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105,855—J. T. Slingerland.....July 26, 1870
108,980—M. de la Pena.....Nov. 8, 1870
110,077—W. S. Shipley.....Dec. 13, 1870
113,912—F. M. Neff & J. E. Scruggs...April 18, 1871
114,850—T. J. Plunket.....May 16, 1871
120,398—D. B. Ray.....Oct. 31, 1871
126,262—O. L. Brown.....April 30, 1872
126,944—J. M. Farnham.....May 21, 1872
130,485—A. Corey.....Aug. 13, 1872
130,982—A. Corey.....Sept. 3, 1872
136,018—W. H. Baldwin.....Feb. 18, 1873
137,466—C. T. Moore.....April 1, 1873
138,922—S. H. Orwig.....May 13, 1873
140,279—C. Kastenbein.....June 24, 1873
142,652—D. B. Ray.....Sept. 9, 1873
149,647—F. G. Foster.....April 14, 1874
150,234—J. M. Farnham.....April 28, 1874
152,868—J. A. Reynolds.....July 7, 1874
157,694—J. W. Paige.....Dec. 15, 1874
164,037—A. C. Richards.....June 1, 1875
166,549—W. D. C. Pattyson.....Aug. 10, 1875
167,726—R. T. P. Allen.....Sept. 14, 1875
168,044—A. Millar.....Sept. 21, 1875
168,591—D. B. Thompson.....Oct. 11, 1875
170,372—J. Hooker.....Nov. 23, 1875
170,593—A. C. Richards.....Nov. 30, 1875
174,901—C. W. Dickinson.....Mar. 21, 1876
174,916—W. A. Lorenz.....Mar. 21, 1876
175,938—A. Corey.....April 11, 1876
196,826—D. Reynolds & J. Thorne.....Nov. 6, 1877

212,504—A. C. Richards.....Feb. 18, 1879
221,853—J. North.....Nov. 18, 1879
224,166—A. Fraser.....Feb. 3, 1880
225,468—P. Dillon.....Mar. 16, 1880
226,297—A. Fraser.....April 6, 1880
230,784—L. K. Johnson.....Aug. 3, 1880
232,157—J. Thorne.....Sept. 14, 1880
244,634—W. A. Lorenz.....July 19, 1881
244,725—W. A. Lorenz & L. K. Johnson July 19, 1881
248,047—W. A. Lorenz.....Oct. 11, 1881
250,555—W. A. Lorenz & L. K. Johnson..Dec. 6, 1881
251,380—D. Reynolds.....Dec. 27, 1881
253,153—E. W. Brackelsberg.....Jan. 31, 1882
255,667—T. J. Porter.....Mar. 28, 1882
261,378—J. North.....July 18, 1882
264,084—L. K. Johnson.....Sept. 12, 1882
264,085—L. K. Johnson & A. A. Low...Sept. 12, 1882
268,409—L. K. Johnson & A. A. Low....Dec. 5, 1882
271,711—L. K. Johnson & A. A. Low...Feb. 6, 1883
275,664—L. K. Johnson & A. A. Low..April 10, 1883
277,740—L. K. Johnson & A. A. Low...May 15, 1883
279,168—L. K. Johnson & A. A. Low...June 12, 1883
280,699—F. Wicks.....July 3, 1883
283,934—J. Thorne.....Aug. 28, 1883
336,719—L. K. Johnson & A. A. Low...Feb. 23, 1886
347,626—J. L. McMillan.....Aug. 17, 1886
348,836—C. G. Fischer.....Sept. 7, 1886
358,041—L. K. Johnson & A. A. Low...Feb. 22, 1887
360,355—A. A. Low.....Mar. 29, 1887
360,356—A. A. Low.....Mar. 29, 1887
360,357—A. A. Low.....Mar. 29, 1887
360,358—A. A. Low.....Mar. 29, 1887

362,751—A. Lagerman.....May 10, 1887
369,104—A. A. Low.....Mar. 29, 1887
369,720—L. K. Johnson.....Sept. 13, 1887
372,186—J. Thorne.....Oct. 25, 1887
372,187—J. Thorne.....Oct. 25, 1887
375,757—A. A. Low.....Jan. 3, 1888
375,758—A. A. Low.....Jan. 3, 1888
381,802—A. A. Low.....April 24, 1888
386,783—L. K. Johnson & A. A. Low...July 24, 1888
387,546—J. Thorne.....Aug. 7, 1888
388,088—J. Thorne.....Aug. 21, 1888
392,358—J. B. Odell.....Nov. 6, 1888
402,537—R. W. Nelson.....April 30, 1889
405,273—G. D. Rogers.....June 18, 1889
412,606—L. Dow.....Oct. 8, 1889
412,714—L. Dow.....Oct. 8, 1889
417,057—T. J. Lumis.....Dec. 10, 1889
418,321—J. B. Odell.....Dec. 31, 1889
418,664—W. Dreyer.....Dec. 31, 1889
419,119—J. Gustafson.....Jan. 7, 1890
422,122—P. P. Craven.....Feb. 25, 1890
427,685—J. Gustafson.....May 13, 1890
427,947—G. G. Allen.....May 13, 1890
428,906—J. Gustafson.....May 27, 1890
429,754—J. W. Chadwick.....June 10, 1890
430,624—R. Clay & J. E. Marchant....June 24, 1890
433,030—G. P. Prescott.....July 29, 1890
434,942—J. B. Odell.....Aug. 26, 1890
445,702—A. A. Low.....Feb. 3, 1891
448,735—E. C. Standiford & S. A. Hyers.Mar. 24, 1891
453,257—J. Gustafson.....June 2, 1891
465,876—J. L. McMillan.....Dec. 29, 1891

465,877—J. L. McMillan.....Dec. 29, 1891
467,335—W. A. Lorenz.....Jan. 19, 1892
467,631—E. J. Andrews.....Jan. 26, 1892
467,640—T. J. Lumis.....Jan. 26, 1892
468,570—T. J. Lumis.....Feb. 9, 1892
473,405—R. W. Nelson.....April 19, 1892
473,691—G. A. Botton.....April 26, 1892
477,008—L. K. Johnson.....June 14, 1892
480,497—W. W. Hastings & F. D. Foster. Aug. 9, 1892
488,265—J. Hooker.....Dec. 20, 1892
492,164—J. A. Kay.....Feb. 21, 1893
493,448—A. V. Ruchmich.....Mar. 14, 1893
494,564—J. I. Haynes.....April 4, 1893
494,572—L. K. Johnson.....April 4, 1893
494,573—L. K. Johnson.....April 4, 1893
495,588—J. Hooker.....April 18, 1893
499,506—W. W. & J. M. Bishop.....June 13, 1893
505,200—J. Hooker.....Sept. 19, 1893
517,144—L. K. Johnson .....Mar. 27, 1894
520,311—C. F. Hilder.....May 22, 1894
522,714—L. K. Johnson & A. A. Low...July 10, 1894
522,715—L. K. Johnson & A. A. Low...July 10, 1894
522,716—L. K. Johnson & A. A. Low...July 10, 1894
523,740—L. K. Johnson.....July 31, 1894
523,741—L. K. Johnson.....July 31, 1894
523,742—L. K. Johnson & A. A. Low...July 31, 1894
523,743—L. K. Johnson & A. A. Low...July 31, 1894
523,744—L. K. Johnson.....July 31, 1894
523,745—L. K. Johnson & A. A. Low...July 31, 1894
524,692—F. Praunegger.....Aug. 14, 1894
528,855—P. F. Cox .....Nov. 6, 1894
528,856—P. F. Cox .....Nov. 6, 1894

529,446—L. K. Johnson & A. A. Low...Nov. 20, 1894
529,447—L. K. Johnson & A. A. Low...Nov. 20, 1894
529,497—L. K. Johnson & A. A. Low...Nov. 20, 1894
534,439—L. K. Johnson.....Feb. 19, 1895
539,716—F. Wicks.....May 21, 1895
539,946—L. K. Johnson.....May 28, 1895
539,947—L. K. Johnson.....May 28, 1895
539,948—L. K. Johnson.....May 28, 1895
539,949—L. K. Johnson & A. A. Low...May 28, 1895
539,950—L. K. Johnson & A. A. Low...May 28, 1895
539,951—L. K. Johnson & A. A. Low...May 28, 1895
539,952—L. K. Johnson & A. A. Low...May 28, 1895
540,055—C. F. Hilder.....May 28, 1895
540,914—A. S. Hoge.....June 11, 1895
541,217—F. Q. Stuart.....June 18, 1895
547,859—J. W. Paige.....Oct. 15, 1895
547,860—J. W. Paige.....Oct. 15, 1895
548,045—C. R. Ferguson.....Oct. 15, 1895
550,554—P. F. Cox.....Nov. 26, 1895
551,384—L. K. Johnson & A. A. Low...Dec. 17, 1895
551,385—L. K. Johnson & A. A. Low...Dec. 17, 1895
551,386—L. K. Johnson & A. A. Low...Dec. 17, 1895
551,387—L. K. Johnson & A. A. Low...Dec. 17, 1895
559,707—C. F. Hilder.....May 5, 1896
561,993—L. K. Johnson & A. A. Low...June 16, 1896
562,078—L. K. Johnson & A. A. Low...June 16, 1896
562,079—L. K. Johnson & A. A. Low...June 16, 1896
562,080—L. K. Johnson & A. A. Low...June 16, 1896
562,081—L. K. Johnson & A. A. Low....June 16, 1896
562,082—L. K. Johnson & A. A. Low...June 16, 1896
562,083—L. K. Johnson & A. A. Low...June 16, 1896
564,075—S. H. & P. E. Hodgkin.....July 14, 1896

564,076—S. H. & P. E. Hodgkin.....July 14, 1896
567,212—E. J. Andrews.....Sept. 8, 1896
567,256—J. Sachs.....Sept. 8, 1896
569,337—L. K. Johnson & A. A. Low...Oct. 13, 1896
570,098—L. K. Johnson & A. A. Low....Oct 27, 1896
576,731—L. K. Johnson & A. A. Low...Feb. 9, 1897
578,414—R. J. Moxley.....Mar. 9, 1897
578,713—J. B. Bell.....Mar. 16, 1897
579,541—L. K. Johnson & A. A. Low...Mar. 23, 1897
583,478—L. K. Johnson & A. A. Low....June 1, 1897
583,479—L. K. Johnson & A. A. Low....June 1, 1897
583,480—L. K. Johnson & A. A. Low....June 1, 1897
586,237—L. K. Johnson & A. A. Low...July 13, 1897
586,287—L. K. Johnson & A. A. Low...July 13, 1897
591,914—C. W. Dickinson.....Oct. 19, 1897
593,667—L. K. Johnson & A. A. Low...Nov. 16, 1897
593,668—L. K. Johnson & A. A. Low...Nov. 16, 1897
596,598—L. K. Johnson & A. A. Low....Jan. 4, 1898
599,390—L. K. Johnson & A. A. Low...Feb. 22, 1898
602,327—S. H. & P. E. Hodgkin.....April 12, 1898
606,678—R. J. Moxley.....July 5, 1898
614,661—E. F. Linke.....Nov. 22, 1898
614,662—E. F. Linke and G. L. Willey.Nov. 22, 1898
618,463—L. K. Johnson & A. A. Low...Jan. 31, 1898
625,931—L. K. Johnson & A. A. Low...May 30, 1899
626,758—C. D. Hughes.....June 13, 1899
626,914—E. F. Linke.....June 13, 1899
630,772—C. J. Botz.....Aug. 8, 1899
630,831—L. K. Johnson & A. A. Low....Aug. 8, 1899
630,832—L. K. Johnson & A. A. Low....Aug. 8, 1899
634,214—L. K. Johnson & A. A. Low....Oct. 3, 1899
637,858—A. Dow.....Nov. 28, 1899

639,244—L. K. Johnson & A. A. Low...Dec. 19, 1899
639,245—L. K. Johnson & A. A. Low...Dec. 19, 1899
640,274—F. B. Converse, Jr.....Jan. 2, 1900
641,296—L. K. Johnson & A. A. Low...Jan. 16, 1900
641,297—L. K. Johnson & A. A Low...Jan. 16, 1900
641,298—L. K. Johnson & A. A. Low...Jan. 16, 1900
641,310—A. A. Low.....Jan. 16, 1900
641,875—F. McClintock.....Jan. 23, 1900
642,335—L. K. Johnson.....Jan. 30, 1900
648,750—L. K. Johnson & A. A. Low...May 1, 1900
650,397—L. K. Johnson & A. A. Low...May 29, 1900
650,398—L. K. Johnson & A. A. Low...May 29, 1900
652,420—H. Burg ..... June 26, 1900
652,421—H. Burg.....June 26, 1900
652,422—H. Burg.....June 26, 1900
653,142—L. K. Johnson & A. A. Low...July 3, 1900
657,282—F. B. Converse, Jr.....Sept. 4, 1900
657,478—T. Cahill.....Sept. 4, 1900
657,546—L. K. Johnson & A. A. Low...Sept. 11, 1900
657,874—L. K. Johnson & A. A. Low..Sept. 11, 1900
658,944—A. Dow.....Oct. 2, 1900
662,652—E. F. Linke.....Nov. 27, 1900
662,724—P. E. Hodgkin & W. May....Nov. 27, 1900
665,406—P. F. Cox.....Jan. 8, 1901
667,049—F. Wicks.....Jan. 29, 1901
668,312—A. A. Low.....Feb. 19, 1901
676,975—W. Berri.....June 25, 1901
693,445—A. V. Ruckmich.....Feb. 18, 1902
694,481—L. K. Johnson & A. A. Low....Mar. 4, 1902
694,488—A. A. Low & A. Breakey.....Mar. 4, 1902
699,390—L. K. Johnson & A. A. Low...May 6, 1902
702,457—F. McClintock.....June 17, 1902

702,458—F. McClintock.....June 17, 1902
703,017—E. Terrell & F. A. Ray.....June 24, 1902
704,183—D. W. Fratcher.....July 8, 1902
708,645—L. K. Johnson & A. A. Low...Sept. 9, 1902
708,646—L. K. Johnson.....Sept. 9, 1902
717,169—F. B. Converse, Jr.....Dec. 30, 1092
717,170—F. B. Converse, Jr.....Dec. 30, 1902
717,171—F. B. Converse, Jr.....Dec. 30, 1902
717,960—E. A. Adcock.....Jan. 6, 1903
742,671—G. E. Kenney.....Oct. 27, 1903
742,672—G. E. Kenney.....Oct. 27, 1903
747,196—A. A. Low & J. Breakey.....Dec. 15, 1903
749,773—F. B. Converse, Jr.....Jan. 19, 1904

INDIVIDUAL TYPE DISTRIBUTORS.

10,656—V. Beaumont.....Mar. 21, 1854
18,264—W. H. Mitchel.....Sept. 22, 1857
100,366—O. L. Brown.....Mar. 1, 1870
102,183—D. B. Thompson.....April 19, 1870
104,236—C. S. Westcott & A. K. Rider.June 14, 1870
115,777—J. T. Slingerland.....June 6, 1871
122,744—D. B. Thompson.....Jan. 16, 1872
138,241—M. Gally.....April 29, 1873
140,278—C. Kastenbein.....June 24, 1873
152,869—J. A. Reynolds.....July 7, 1874
174,147—W. D. C. Pattyson.....Mar. 21, 1876
174,899—C. W. Dickinson.....Mar. 21, 1876
174,900—C. W. Dickinson.....Mar. 21, 1876
174,915—W. A. Lorenz.....Mar. 21, 1876
190,434—J. M. Howe.....May 8, 1877
192,281—D. Reynolds.....June 19, 1877

194,524—W. A. Lorenz & C. D. Hughes..Aug. 28, 1877
195,072—R. T. P. Allen.....Sept. 11, 1877
211,038—J. North.....Dec. 17, 1878
224,167—A. Fraser.....Feb. 3, 1880
226,623—J. North.....April 20, 1880
244,721—L. K. Johnson.....July 19, 1881
244,723—W. A. Lorenz & L. K. Johnson.July 19, 1881
244,724—W. A. Lorenz, E. G. Parkhurst &
L. K. Johnson.....July 19, 1881
245,523—A. A. Low.....Aug. 9, 1881
245,562—T. Reeve.....Aug. 9, 1881
259,578—J. North.....June 13, 1882
282,988—L. K. Johnson & A. A. Low...Aug. 14, 1883
283,762—R. H. Davies.....Aug. 28, 1883
306,283—D. Reynolds.....Oct. 7, 1884
336,645—L. K. Johnson & A. A. Low..Feb. 23, 1886
336,646—L. K. Johnson & A. A. Low..Feb. 23, 1886
336,647—L. K. Johnson.....Feb. 23, 1886
337,406—L. K. Johnson & A. A. Low...Mar. 9, 1886
337,407—L. K. Johnson & A. A. Low...Mar. 9, 1886
340,124—L. K. Johnson & A. A. Low...April 20, 1886
340,125—L. K. Johnson & A. A. Low..April 20, 1886
342,916—H. C. Leland.....June 1, 1886
347,627—J. L. McMillan.....Aug. 17, 1886
354,149—L. K. Johnson & A. A. Low...Dec. 14, 1886
356,840—L. K. Johnson & A. A. Low...Feb. 1, 1887
360,096—L. K. Johnson & A. A. Low...Mar. 29, 1887
360,097—L. K. Johnson & A. A. Low...Mar. 29, 1887
363,836—A. A. Low.....May 31, 1887
372,076—A. A. Low.....Oct. 25, 1887
391,798—L. K. Johnson & A. A. Low...Oct. 30, 1888
392,806—L. K. Johnson & A. A. Low...Nov. 13, 1888

394,255—L. Dow.....Dec. 11, 1888
409,690—A. A. Low.....Aug. 27, 1889
409,748—L. K. Johnson & A. A. Low...Aug. 27, 1889
417,074—R. W. Nelson.....Dec. 10, 1889
421,001—L. K. Johnson & A. A. Low....Feb. 11, 1890
430,007—L. Dow & D. Powers.....June 10, 1890
435,564—L. K. Johnson & A. A. Low...Sept. 2, 1890
436,039—L. K. Johnson & A. A. Low...Sept. 9, 1890
441,750—P. P. Craven.....Dec. 2, 1890
446,235—J. Patten.....Feb. 10, 1891
453,584—L. K. Johnson & A. A. Low....June 2, 1891
457,182—R. Clarke.....Aug. 4, 1891
457,481—J. B. Odell.....Aug. 11, 1891
457,829—O. F. Teed.....Aug. 18, 1891
464,163—J. L. McMillan.....Dec. 1, 1891
464,477—C. H. Joslyn.....Dec. 1, 1891
465,482—H. C. Leland.....Dec. 22, 1891
467,087—L. Dow & D. Powers.....Jan. 12, 1892
477,009—L. K. Johnson.....June 14, 1892
493,270—J. Hooker.....Mar. 14, 1893
501,597—O. S. Bowman .....July 18, 1893
517,802—C. F. Hilder.....April 3, 1894
524,693—F. Praunegger.....Aug. 14, 1894
526,106—L. K. Johnson.....Sept. 18, 1894
531,531—C. F. Hilder.....Dec. 25, 1894
535,111—L. K. Johnson.....Mar. 5, 1895
540,915—A. S. Hoge.....June 11, 1895
541,758—L. K. Johnson.....June 25, 1895
547,392—W. H. Cox.....Oct. 1, 1895
550,553—P. F. Cox.....Nov. 26, 1895
550,555—P. F. Cox.....Nov. 26, 1895
567,252—R. J. Moxley.....Sept. 8, 1896

572,050—A. Dow.....Nov. 24, 1896
572,705—C. D. Hughes.....Dec. 8, 1896
578,216—P. F. Cox.....Mar. 2, 1897
582,743—C. D. Hughes.....May 18, 1897
591,073—P. F. Cox.....Oct. 5, 1897
597,544—R. J. Moxley.....Jan. 23, 1898
604,305—P. F. Cox.....May 17, 1898
609,453—R. J. Moxley.....Aug. 23, 1898
614,660—E. F. Linke.....Nov. 22, 1898
618,475—A. A. Low.....Jan. 31, 1899
646,359—P. F. Cox.....Mar. 27, 1900
646,971—A. Fraser & F. Rose.....April 10, 1900
646,972—A. Fraser & F. Rose.....April 10, 1900
650,405—A. A. Low.....May 29, 1900
651,551—E. F. Linke.....June 12, 1900
652,423—H. Burg.....June 26, 1900
652,480—C. D. Hughes.....June 26, 1900
652,899—E. F. Nydahl.....July 3, 1900
657,309—F. B. Converse.....Sept. 4, 1900
666,280—A. A. Low & J. Breakey.....Jan. 22, 1901
666,323—A. A. Low & J. Breakey.....Jan. 22, 1901
668,314—A. A. Low.....Feb. 19, 1901
668,346—J. Breakey.....Feb. 19, 1901
676,908—E. F. Nydahl & G. A. Harding. June 25, 1901
686,029—E. S. Crane.....Nov. 5, 1901
692,883—A. A. Low & A. Breakey.....Feb. 11, 1902
699,402—A. A. Low & A. Breakey.....May 6, 1902
701,881—P. E. Hodgkin & G. E. Kenney. June 10, 1902
702,555—J. Hinklein.....June 17, 1902
702,621—J. Breakey.....June 17, 1902
710,066—A. A. Low.....Sept. 30, 1902
710,057—L. K. Johnson & A. A. Low..Sept. 30, 1902

738,269—F. Winkler.....Sept. 8, 1903
747,183—L. K. Johnson.....Dec. 15, 1903

JUSTIFIERS.

9,418—E. C. Harmon.....Nov. 23, 1852
30,211—D. B. Dorsey & E. Mathers....Oct. 2, 1860
38,955—C. W. Felt.....June 23, 1863
148,624—D. B. Ray.....Mar. 17, 1874
276,947—F. Wicks.....May 1, 1883
478,340—A. Lagerman.....July 5, 1892
489,834—H. C. & S. D. Snoddy.....Jan. 10, 1893
521,039—J. L. McMillan.....June 5, 1894
528,857—P F. Cox.....Nov. 6, 1894
534,550—P. F. Cox.....Feb. 19, 1895
547,861—J. W. Paige & C. R. North...Oct. 15, 1895
565,749—C. F. Hilder.....Aug. 11, 1896
581,954—P. F. Cox.....May 4, 1897
583,224—W. J. Ennisson & W. H. Honiss.May 25, 1897
584,361—F. A. Johnson.....June 15, 1897
584,362—F. A. Johnson.....June 15, 1897
592,743—C. W. Bowron.....Oct. 26, 1897
601,498—P. F. Cox.....Mar. 29, 1898
601,706—F. B. Converse, Jr.....April 5, 1898
607,045—F. A. Johnson.....July 12, 1898
607,046—F. A. Johnson.....July 12, 1898
607,047—F. A. Johnson.....July 12, 1898
608,002—F. McClintock.....July 26, 1898
608,997—P. H. McGrath.....Aug. 9, 1898
612,010—W. Berri.....Oct. 11, 1898
614,319—J. D. Chalfant.....Nov. 15, 1898
618,800—C. R. Murray.....Jan. 31, 1899
631,062—P. F. Cox.....Aug. 15, 1899

633,309—C. W. Dickinson.....Sept. 19, 1899
635,866—F. McClintock.....Oct. 31, 1899
643,473—P. F. Cox .....Feb. 13, 1900
645,512—P. H. McGrath.....Mar. 13, 1900
645,801—H. J. S. Gilbert-Stringer and F. Wicks.....Mar. 20, 1900
646,358—P. F. Cox.....Mar. 27, 1900
652,342—C. W. Bowron.....June 26, 1900
660,163—P. H. McGrath.....Oct. 23, 1900
672,131—L. E. & H. S. Merrill.....April 16, 1901
693,145—F. McClintock.....Feb. 11, 1902
695,017—J. Watson.....Mar. 11, 1902
700,699—F. McClintock.....May 20, 1902
700,700—F. McClintock.....May 20, 1902
700,701—F. McClintock.....May 20, 1902
700,712—J. Watson.....May 20, 1902
701,811—F. Holdsworth.....June 3, 1902
702,459—F.McClintock & F.Holdsworth.June 17, 1902
705,693—E. Mullendorff.....July 29, 1902
716,236—F. A. Johnson.....Dec. 16, 1902
731,666—C. H. Cochrane.....June 23, 1903
738,741—F. B. Converse, Jr.....Sept. 8, 1903
740,537—C. H. Cochrane.....Oct. 6, 1903
746,295—F. B. Converse, Jr.....Dec. 8, 1903
749,720—F. B. Converse, Jr.....Jan. 19, 1904
753,336—J. A. Watson.....Mar. 1, 1904

TYPE CASTERS AND SETTERS.

115,796—C. S. Westcott.....June 6, 1871
169,215—C. S. Westcott.....Oct. 26, 1875
169,216—C. S. Westcott.....Oct. 26, 1875
193,628—C. S. Westcott.....July 31, 1877

532,368—J. C. Fowler.....Jan. 8, 1895
542,140—L. A. Brott & G. A. Kay.....July 2, 1895
558,145—W. Berri.....April 14, 1896
618,926—F. Wicks.....Feb. 7, 1899
642,441—H. J. S. Gilbert-Stringer.....Jan. 30, 1900
644,835—M. W. Smith.....Mar. 6, 1900
656,820—F. Wicks.....Aug. 11, 1896
667,210—J. C. Fowler.....Feb. 5, 1901
667,211—J. C. Fowler.....Feb. 5, 1901
667,212—J. C. Fowler & J. C. Fowler, Jr..Feb. 5, 1901
669,405—F. Wicks.....Mar. 5, 1901
671,362—F. Wicks.....April 2, 1901
675,827—H. J. S. Gilbert-Stringer.....June 4, 1901
675,828—H. J. S. Gilbert-Stringer.....June 4, 1901
675,829—H. J. S. Gilbert-Stringer.....June 4, 1901
690,720—H. J. S. Gilbert-Stringer.....Jan. 7, 1902
691,619—H. J. S. Gilbert-Stringer....Jan. 21, 1902
705,525—J. C. Fowler & J. C. Fowler, Jr.July 22,1902
727,046—F. Wicks.....May 5, 1903
734,597—F. E. Peacock.....July 28, 1903
748,578—B. A. Brooks.....Jan. 5, 1904
765,965—J. C. Fowler.....July 26, 1904

TYPE-BAR MACHINES.

540,743—W. Kemp, Jr.....June 11, 1895
543,272—C. Skatulla.....July 23, 1895
552,745—V. Calendoli.....Jan. 7, 1896
606,656—M. Gally.....July 5, 1898
606,657—M. Gally.....July 5, 1898
637,086—J. D. C. Chateau.....Nov. 14, 1899
694,306—L. A. Brott.....Feb. 25, 1902
694,307—L. A. Brott.....Feb. 25, 1902

694,308—L. A. Brott.....Feb. 25, 1902
694,309—L. A. Brott.....Feb. 25, 1902
694,310—L. A. Brott.....Feb. 25, 1902

IMPRESSION DEVICES.

20,081—J. McElheran.....April 27, 1858
21,208—J. McElheran.....Aug. 17, 1858
24,662—D. B. Ray.....July 5, 1859
52,073—J. Paulding.....Jan. 16, 1866
72,515—J. MacNair.....Dec. 24, 1867
108,813—W. T. Morgans.....Nov. 1, 1870
129,331—M. Gally.....July 16, 1872
129,725—M. Gally.....July 23, 1872
222,642—J. W. Schuckers.....Dec. 16, 1879
253,057—J. P. Hunt.....Jan. 31, 1882
265,918—M. H. Dement.....Oct. 10, 1882
282,176—M. H. Dement.....July 31, 1883
285,470—M. H. Dement & A. W. Grandville
.....Sept. 25, 1883
302,653—M. H. Dement.....July 29, 1884
306,423—O. M. Peterson.....Oct. 14, 1884
307,446—M. H. Dement.....Nov. 4, 1884
311,350—O. Mergenthaler.....Jan. 27, 1885
311,400—J. H. White.....Jan. 27, 1885
311,411—J. O. Clephane.....Jan. 27, 1885
311,412—J. O. Clephane.....Jan. 27, 1885
311,413—J. O. Clephane.....Jan. 27, 1885
311,414—J. O. Clephane.....Jan. 27, 1885
312,145—O. Mergenthaler.....Feb. 10, 1885
328,960—O. Mergenthaler.....Oct. 27, 1885
329,466—F. D. Maltby.....Nov. 3, 1885
332,352—F. D. Maltby.....Dec. 15, 1885

332,354—O. Mergenthaler.....Dec. 15, 1885
336,753—F. Schreiner.....Feb. 23, 1886
336,754—F. Schreiner.....Feb. 23, 1886
339,609—T. D. Worrall.....April 6, 1886
339,724—T. D. Worrall.....April 13, 1886
344,974—O. Mergenthaler.....July 6, 1886
347,818—O. Mergenthaler.....Aug. 24, 1886
376,541—O. Mergenthaler.....Jan. 17, 1888
389,108—J. R. Rogers.....Sept. 4, 1888
403,075—W. Rennyson.....May 7, 1889
423,688—W. J. Howell.....Mar. 18, 1890
423,689—W. J. Howell.....Mar. 18, 1890
435,777—R. H. St. John.....Sept. 2, 1890
440,086—E. Wright.....Nov. 4, 1890
442,551—R. H. St. John.....Dec. 9, 1890
445,559—F. A. Johnson & W. E. Crane..Feb. 3, 1891
446,930—C. Sears.....Feb. 24, 1891
447,134—H. Lee & E. Lebrun.....Feb. 24, 1891
447,135—H. Lee.....Feb. 24, 1891
463,388—F. A. Johnson.....Nov. 17, 1891
478,333—F. A. Johnson.....July 5, 1892
483,252—T. T. Heath & A. N. Verdin..Sept. 27, 1892
485,655—L. Ransom & A. W. Maynes...Nov. 8, 1892
485,702—A. J. Kletzker & J. G. Goesel...Nov. 8, 1892
490,263—E. V. Beals.....Jan. 24, 1893
508,186—C. Sears.....Nov. 7, 1893
508,248—C. Sears.....Nov. 7, 1893
510,032—V. F. Lake & I. Risley.....Dec. 5, 1893
520,238—H. W. Libbey.....May 22, 1894
533,285—J. C. Fowler.....Jan. 29, 1895
533,389—J. C. Fowler.....Jan. 29, 1895
539,253—A. C. Ferguson.....May 14, 1895

541,445—J. Rupertus.....June 18, 1895
542,224—H. Lee & E. Lebrun.....July 2, 1895
551,469—H. Lee & E. Lebrun.....Dec. 17, 1895
553,909—T. T. Heath & A. N. Verdin...Feb. 4, 1896
553,983—T. T. Heath & A. N. Verdin...Feb. 4, 1896
553,984—T. T. Heath & A. N. Verdin...Feb. 4, 1896
553,985—T. T. Heath & A. N. Verdin....Feb. 4, 1896
553,986—T. T. Heath & A. N. Verdin...Feb. 4, 1896
553,987—T. T. Heath.....Feb. 4, 1896
553,988—T. T. Heath & A. N. Verdin...Feb. 4, 1896
555,519—H. W. Libbey.....Mar. 3, 1896
574,935—O. M. Peterson.....Jan. 12, 1897
574,936—O. M. Peterson & C. C. Hill....Jan. 12, 1897
578,713—J. B. Bell.....Mar. 16, 1897
584,363—F. A. Johnson.....June 15, 1897
584,364—F. A. Johnson.....June 15, 1897
587,816—T. T. Heath.....Aug. 10, 1897
588,087—I. Risley.....Aug. 10, 1897
589,470—T. T. Heath.....Sept. 7, 1897
610,231—M. Gally.....Sept. 6, 1898
618,044—P. T. Dodge.....Jan. 17, 1899
620,183—I. Risley & V. F. Lake.....Feb. 28, 1899
626,098—I. Risley & V. F. Lake.....May 30, 1899
632,484—E. V. Beals.....Sept. 5, 1899
634,715—E. V. Beals & W. B. Norton...Oct. 10, 1899
635,649—B. A. Brooks.....Oct. 24, 1899
642,263—C. Sears.....Jan. 30, 1900
642,264—C. Sears .....Jan. 30, 1900
646,547—C. Sears.....April 3, 1900
650,934—J. C. Fowler.....June 5, 1900
657,039—R. H. St. John.....Aug. 28, 1900
657,040—R. H. St. John.....Aug. 28, 1900

657,041—R. H. St. John.....Aug. 28, 1900
657,042—R. H. St. John.....Aug. 28, 1900
657,043—R. H. St. John.....Aug. 28, 1900
696,360—E. V. Beals.....Mar. 25, 1902
734,597—F. E. Peacock.....July 28, 1903
743,890—A. Kraus & N. Collins.....Nov. 10, 1903

SLUGCASTING MACHINES.

313,224—O. Mergenthaler.....Mar. 3, 1885
317,828—O. Mergenthaler.....May 12, 1885
328,961—O. Mergenthaler.....Oct. 27, 1885
345,525—O. Mergenthaler.....July 13, 1886
345,526—O. Mergenthaler.....July 13, 1886
347,629—O. Mergenthaler.....Aug. 17, 1886
347,630—O. Mergenthaler.....Aug. 17, 1886
378,797—O. Mergenthaler.....Feb. 28, 1888
378,798—O. Mergenthaler.....Feb. 28, 1888
392,446—O. Mergenthaler.....Nov. 6, 1888
393,846—O. Mergenthaler.....Dec. 4, 1888
413,042—A. J. Engeler.....Oct. 15, 1889
417,142—B. A. Brooks.....Dec. 10, 1889
425,140—O. Mergenthaler.....April 8, 1890
436,531—O. Mergenthaler.....Sept. 16, 1890
436,532—O. Mergenthaler.....Sept. 16, 1890
437,139—J. R. Rogers.....Sept. 23, 1890
437,141—F. E. Bright.....Sept. 23, 1890
438,354—O. Mergenthaler.....Oct. 14, 1890
443,085—G. Corsa.....Dec. 23, 1890
443,086—G. Corsa.....Dec. 23, 1890
444,090—W. S. Scudder.....Jan. 6, 1891
444,294—P. T. Dodge.....Jan. 6, 1891
444,337—P. T. Dodge.....Jan. 6, 1891

446,738—E. A. Henkle & J. C. Fowler..Feb. 17, 1891
449,872—P. T. Dodge.....April 7, 1891
453,962—J. O. Clephane.....June 9, 1891
458,314—J. O. Clephane.....Aug. 25, 1891
461,338—E. A. Henkle & J. C. Fowler..Oct. 13, 1891
466,666—P. T. Dodge.....Jan. 5, 1892
470,649—J. C. Fowler.....Mar. 8, 1892
472,966—M. Georgii.....April 12, 1892
474,306—J. W. Schuckers.....May 3, 1892
481,920—J. C. Fowler.....Aug. 30, 1892
483,023—J. Slocum.....Sept. 20, 1892
489,503—C. Sears.....Jan. 10, 1893
490,739—I. McK. Chase.....Jan. 31, 1893
494,899—W. S. Scudder.....April 4, 1893
498,425—J. C. Fowler.....May 30, 1893
498,426—J. C. Fowler.....May 30, 1893
499,278—W. Berri.....June 13, 1893
506,198—W. S. Scudder.....Oct. 3, 1893
510,853—J. C. Fowler.....Dec. 12, 1893
513,007—G. A. Dubeux.....Jan. 13, 1894
513,958—C. Skatulla.....Jan. 30, 1894
515,623—H. A. Stall.....Feb. 27, 1894
518,063—M. M. Gillam.....April 10, 1894
520,140—C. Forth & H. Glenzer.....May 22, 1894
520,158—P. T. Dodge.....May 22, 1894
520,465—W. Weatherby.....May 29, 1894
522,073—O. Mergenthaler.....June 26, 1894
524,285—O. V. Sigurdsson.....Aug. 7, 1894
527,702—O. Mergenthaler.....Oct. 16, 1894
529,205—C. Skatulla.....Nov. 13, 1894
529,448—A. S. Capehart.....Nov. 20, 1894
530,931—P. T. Dodge.....Dec. 18, 1894

531,266—O. Mergenthaler.....Dec. 18, 1894
531,786—P. T. Dodge.....Jan. 1, 1895
533,346—C. M. Busch.....Jan. 29, 1895
534,917—J. R. Rogers.....Feb. 25, 1895
537,668—R. A. Berger.....April 16, 1895
538,094—C. P. Woodruff.....April 23, 1895
538,100—P. T. Dodge.....April 23, 1895
538,123—J. L. Ripsom.....April 23, 1895
538,133—C. Skatulla.....April 23, 1895
538,176—O. Mergenthaler.....April 23, 1895
538,902—J. A. Erkson.....May 7, 1895
539,983—P. T. Dodge.....May 28, 1895
539,984—P. T. Dodge.....May 28, 1895
539,985—P. T. Dodge.....May 28, 1895
539,986—P. T. Dodge.....May 28, 1895
539,992—L. F. Mather.....May 28, 1895
539,993—O. Mergenthaler.....May 28, 1895
539,994—C. Muehleisen.....May 28, 1895
540,000—J. Place.....May 28, 1895
540,001—J. Place.....May 28, 1895
540,002—J. Place.....May 28, 1895
541,353—A. W. Hanigan.....June 18, 1895
543,497—O. Mergenthaler.....July 30, 1895
545,530—A. D. Pentz.....Sept. 3, 1895
546,054—A. D. Pentz.....Sept. 10, 1895
546,610—J. C. Fowler.....Sept. 17, 1895
547,448—F. Peterhansl.....Oct. 8, 1895
547,633—P. T. Dodge.....Oct. 8, 1895
548,432—P. T. Dodge.....Oct. 22, 1895
551,981—O. Mergenthaler.....Dec. 24, 1895
552,830—J. C. Fowler.....Jan. 7, 1896
554,770—J. Burger.....Feb. 18, 1896

554,790—J. W. Phelps.....Feb. 18, 1896
554,791—J. W. Phelps.....Feb. 18, 1896
554,842—S. Smith.....Feb. 18, 1896
556,517—F. Peterhansl.....Mar. 17, 1896
556,993—N. A. Larkin.....Mar. 24, 1896
557,000—O. Mergenthaler.....Mar. 24, 1896
557,184—F. E. Bright.....Mar. 31, 1896
557,232—J. R. Rogers.....Mar. 31, 1896
557,540—W. Berri.....April 7, 1896
557,541—W. Berri.....April 7, 1896
557,716—H. T. Sundstrom.....April 7, 1896
558,406—O. Mergenthaler..... April 14, 1896
560,000—C. Holliwell.....May 12, 1896
560,459—C. A. Albrecht.....May 19, 1896
560,537—W. H. Randall.....May 19, 1896
562,560—M. H. Whittaker.....June 23, 1896
562,563—C. E. Allen.....June 23, 1896
562,751—A. H. Alexander.....June 23, 1896
562,816—C. Forth.....June 30, 1896
562,954—C. Forth.....June 30, 1896
562,955—C. Forth.....June 30, 1896
563,643—E. Bertram & E. Sanders.....July 7, 1896
563,865—O. Mergenthaler.....July 14, 1896
563,868—C. Muehleisen.....July 14, 1896
565,262—A. B. Adair.....Aug. 4, 1896
565,439—P. T. Dodge.....Aug. 11, 1896
565,440—P. T. Dodge.....Aug. 11, 1896
565,441—P. T. Dodge.....Aug. 11, 1896
565,483—O. Mergenthaler.....Aug. 11, 1896
565,484—O. Mergenthaler.....Aug. 11, 1896
565,485—O. Mergenthaler & C. Muehleisen
.....Aug. 11, 1896

565,486—O. Mergenthaler.....Aug. 11, 1896
565,487—O. Mergenthaler.....Aug. 11, 1896
565,488—O. Mergenthaler.....Aug. 11, 1896
565,489—O. Mergenthaler.....Aug. 11, 1896
565,490—O. Mergenthaler.....Aug. 11, 1896
565,514—W. S. Scudder.....Aug. 11, 1896
565,515—W. S. Scudder.....Aug. 11, 1896
571,809—A. W. Storm.....Nov. 24, 1896
572,947—G. A. Bates.....Dec. 15, 1896
572,974—B. L. Fairchild.....Dec. 15, 1896
573,199—W. Berri.....Dec. 15, 1896
573,383—P. T. Balls.....Dec. 15, 1896
576,397—P. T. Dodge.....Feb. 2, 1897
576,409—J. MacKirby.....Feb. 2, 1897
576,414—J. Place.....Feb. 2, 1897
576,584—T. H. Keller.....Feb. 9, 1897
578,065—H. F. Meistrell.....Mar. 2, 1897
579,292—A. S. Capehart.....Mar. 23, 1897
579,293—A. S. Capehart.....Mar. 23, 1897
583,360—P. T. Dodge.....May 25, 1897
586,337—D. S. Kennedy.....July 13, 1897
588,770—W. Lyon.....Aug. 24, 1897
589,636—C. J. Botz.....Sept. 7, 1897
591,777—C. Sears.....Oct. 12, 1897
591,814—A. S. Capehart.....Oct. 19, 1897
591,947—A. S. Capehart.....Oct. 19, 1897
591,948—A. S. Capehart.....Oct. 19, 1897
595,079—W. S. Scudder.....Dec. 7, 1897
596,340—C. Sears.....Dec. 28, 1897
598,408—B. F. Bellows.....Feb. 1, 1898
598,622—B. F. Bellows.....Feb. 8, 1898
602,004—F. A. Hill & W. E. Shehan...April 26, 1898

604,123—B. Ring & B. W. Stickney...May 17, 1898
604,378—L. Fisher & E. W. Reynolds..May 24, 1898
604,404—G. E. Lincoln.....May 24, 1898
605,141—W. S. Scudder.....June 7, 1898
605,618—E. Wentscher.....June 14, 1898
605,701—P. T. Dodge.....June 14, 1898
605,777—T. Cahill.....June 14, 1898
606,168—T. H. Keller.....June 21, 1898
607,758—G. W. Mascord.....July 19, 1898
608,067—C. Muehleisen.....July 26, 1898
608,155—C. Muehleisen.....July 26, 1898
609,315—W. Wynne.....Aug. 16, 1898
609,770—G. A. Bates.....Aug. 30, 1898
609,883—E. Girod.....Aug. 30, 1898
610,228—T. H. Catherall.....Sept. 6, 1898
610,454—C. Muehleisen.....Sept. 6, 1898
613,724—H. R. Rogers.....Nov. 8, 1898
613,818—C. L. Ireland.....Nov. 8, 1898
613,831—F. J. Wich .....Nov. 8, 1898
614,229—O. Mergenthaler.....Nov. 15, 1898
614,230—O. Mergenthaler.....Nov. 15, 1898
614,550—C. L. Ireland & F. J. Wich....Nov. 22, 1898
614,561—W. J. Lewis, H. Pearce & C. Holliwell
.....Nov. 22, 1898
614,562—W. H. Lock & J. Place.....Nov. 22, 1898
614,582—O. V. Sigurdsson.....Nov. 22, 1898
614,588—F. J. Wich & C. L. Ireland...Nov. 22, 1898
614,589—F. J. Wich & C. L. Ireland...Nov. 22, 1898
614,590—F. J. Wich.....Nov. 22, 1898
614,602—G. A. Bates.....Nov. 22, 1898
614,762—T. P. Ritzema.....Nov. 22, 1898
615,909—J. R. Rogers.....Dec. 13, 1898

618,308—F. J. Wich.....Jan. 24, 1899
618,348—J. D. Harvey.....Jan. 24, 1899
618,554—G. A. Bates.....Jan. 31, 1899
618,582—L. B. Pendelton.....Jan. 31, 1899
618,618—F. B. Reed.....Jan. 31, 1899
619,392—W. S. Coe.....Feb. 14, 1899
619,393—W. S. Coe.....Feb. 14, 1899
619,441—J. R. Rogers.....Feb. 14, 1899
619,875—P. T. Dodge.....Feb. 21, 1899
620,288—A. E. Dowell.....Feb. 28, 1899
620,289—A. E. Dowell.....Feb. 28, 1899
620,381—W. C. Trownsell & J. R. Trego Feb. 28, 1899
620,804—J. R. Rogers.....Mar. 7. 1899
621,329—H. J. Derbyshire.....Mar. 21, 1899
622,989—W. E. Bertram.....April 11, 1899
623,014—A.W. Hanigan & G. H.Yardly.April 11, 1899
623,075—J. N. Chamberlain.....April 11, 1899
624,454—L. M. Chapman & J. M. Gelatt.May 9, 1899
625,445—J. D. Harvey.....May 23, 1899
625,679—C.A.Hollenbeck & R.F.Wilson.May 23, 1899
625,972—E. Girod.....May 30, 1899
629,459—B. Nadall & M. Barr.....July 25, 1899
630,112—J. R. Rogers.....Aug. 1, 1899
630,396—B. Nadall.....Aug. 8, 1899
630,412—J. R. Rogers.....Aug. 8, 1899
631,989—A. Greenleaf.....Aug. 29, 1899
633,190—A. S. Gilman.....Sept. 19, 1899
634,536—C. Muehleisen.....Oct. 10, 1899
635,305—H. J. Derbyshire.....Oct. 24, 1899
635,640—G. A. Bates.....Oct. 24, 1899
635,830—F. J. Wich.....Oct. 31, 1899
635,997—F. C. Dolby.....Oct. 31, 1899

635,998—R. C. Elliott.....Oct. 31, 1899
636,001—C. L. Ireland.....Oct. 31, 1899
636,390—W. Reid & F. Hess.....Nov. 7, 1899
636,622—D. Z. Borne & J. Frey.....Nov. 7, 1899
636,686—C. A. Nelson.....Nov. 7, 1899
637,117—C. Holliwell & W. J. Lewis..Nov. 14, 1899
638,866—F. C. Damm.....Dec. 12, 1899
638,868—E. Girod.....Dec. 12, 1899
639,077—H. F. Meistrell.....Dec. 12, 1899
640,032—J. R. Rogers.....Dec. 26, 1899
640,033—J. R. Rogers.....Dec. 26, 1899
640,119—R. C. Elliott.....Dec. 26, 1899
640,867—F. E. Bright.....Jan. 9, 1900
643,274—J. Place.....Feb. 13, 1900
643,289—D. A. Hensley.....Feb. 13, 1900
643,292—C. Holliwell & R. C. Elliott..Feb. 13, 1900
643,329—J. MacKirdy.....Feb. 13, 1900
643,976—J. Place.....Feb. 20, 1900
644,363—O. Mergenthaler.....Feb. 27, 1900
644,558—P. C. Lawless.....Feb. 27, 1900
645,073—W. H. Doolittle.....Mar. 13, 1900
645,438—J. S. Thompson.....Mar. 13, 1900
645,472—C. Holliwell.....Mar. 13, 1900
646,227—E. G. Leonard.....Mar. 27, 1900
646,953—J. N. Chamberlain.....April 10, 1900
648,449—F. J. Wich.....May 1, 1900
649,110—T. P. Ritzema.....May 8, 1900
650,296—S. Bradley.....May 22, 1900
651,496—S. Smith.....June 12, 1900
652,855—C. Muehleisen.....July 3, 1900
652,881—G. A. Bates.....July 3, 1900
653,151—F. H. Preipon.....July 3, 1900

657,429—J. H. Lynch.....Sept. 4, 1900
658,740—O. Mergenthaler.....Sept. 25, 1900
659,525—A. W. Hanigan.....Oct. 9, 1900
659,800—W. C. Pritchard.....Oct. 16, 1900
659,863—G. A. Vassberg.....Oct. 16, 1900
659,865—G. A. Bates.....Oct. 16, 1900
660,263—A. W. Storm.....Oct. 23, 1900
661,386—J. R. Rogers.....Nov. 6, 1900
662,106—F. J. Wich.....Nov. 20, 1900
664,860—D. A. Hensley.....Jan. 1, 1901
665,212—I. Hall.....Jan. 1, 1901
665,326—I. Hall.....Jan. 1, 1901
666,412—J. Donegan.....Jan. 22, 1901
666,817—C. C. Pugh.....Jan. 29, 1901
666,882—C. Holliwell & R. C. Elliott..Jan. 29, 1901
668,457—J. R. Rogers.....Feb. 19, 1901
669,400—J. R. Rogers.....Mar. 5, 1901
669,401—J. R. Rogers.....Mar. 5, 1901
669,831—D. A. Hensley.....Mar. 12, 1901
670,329—O. Schonauer.....Mar. 19, 1901
672,199—M. H. Whittaker & C. H. West April 16, 1901
672,200—M. H. Whittaker & C. H. West April 16, 1901
674,080—P. T. Dodge.....May 14, 1901
674,092—O. Mergenthaler.....May 14, 1901
676,306—W. Fletcher.....June 11, 1901
678,036—J. R. Rogers.....July 9, 1901
678,268—O. Mergenthaler.....July 9, 1901
678,310—F. A. Vinton.....July 9, 1901
679,479—C. Muehleisen.....July 30, 1901
679,481—J. R. Rogers.....July 30, 1901
679,482—J. R. Rogers.....July 30, 1901
684,104—J. R. Rogers.....Oct. 8, 1901

685,035—P. T. Dodge.....Oct. 22, 1901
685,036—P. T. Dodge.....Oct. 22, 1901
685,583—P. T. Dodge.....Oct. 29, 1901
685,980—A. S. Gilman.....Nov. 5, 1901
687,627—C. Holliwell.....Nov. 26, 1901
687,691—P. C. Lawless.....Nov. 26, 1901
688,218—F. J. Wich.....Dec. 3, 1901
688,812—C. A. Albrecht.....Dec. 17, 1901
689,603—G. A. Vossberg.....Dec. 24, 1901
690,169—G. H. Meserole.....Dec. 31, 1901
690,707—P. T. Dodge.....Jan. 7, 1902
691,583—A. Bean.....Jan. 21, 1902
691,615—R. C. Elliott & C. Holliwell..Jan. 21, 1902
691,685—M. H. Whittaker.....Jan. 21, 1902
692,183—M. P. Freebey.....Jan. 28, 1902
694,141—D. F. Daley.....Feb. 25, 1902
694,269—Z. Halacinski.....Feb. 25, 1902
694,788—J. R. Rogers.....Mar. 4, 1902
694,789—J. R. Rogers.....Mar. 4, 1902
696,532—C. A. Albrecht.....April 1, 1902
696,637—C. Holliwell.....April 1, 1902
696,806—P. T. Dodge.....April 1, 1902
697,011—J. Place & W. J. Lewis.....April 8, 1902
697,456—P. T. Dodge.....April 15, 1902
697,859—F. Lucke.....April 15, 1902
697,968—W. Berri.....April 22, 1902
700,022—P. T. Dodge.....May 13, 1902
701,123—H. C. Zenke.....May 27, 1902
701,989—J. B. Bell.....June 10, 1902
701,990—J. B. Bell.....June 10, 1902
702,781—P. T. Dodge.....June 17, 1902
702,782—P. T. Dodge.....June 17, 1902

702,783—P. T. Dodge.....June 17, 1902
703,248—J. Gray.....June 24, 1902
705,386—A. G. Cotsworth.....July 22, 1092
705,801—F. J. Wich.....July 29, 1902
707,645—O. Mergenthaler & W. J. Hoofnagle
.....Aug. 26, 1902
708,416—A. D. Smith.....Sept. 2, 1902
708,661—J. Pinel.....Sept. 9, 1902
710,652—C. A. Albrecht.....Oct. 7, 1902
711,143—W. W. Wetherspoon.....Oct. 14, 1902
711,288—B. Cole & A. O. Wilson.....Oct. 14, 1892
711,593—G. B. Shepard.....Oct. 21, 1902
711,807—F. J. Wich.....Oct. 21, 1902
712,755—G. A. Bates.....Nov. 4, 1902
712,969—J. Roxburgh & R. McLean....Nov. 4, 1902
713,246—G. B. Shepard.....Nov. 11, 1902
716,975—C. A. Albrecht.....Dec. 30, 1902
718,781—C. Muehleisen.....Jan. 20, 1903
719,270—S. Smith.....Jan. 27, 1903
719,296—H. B. Bartlett.....Jan. 27, 1903
719,422—G. A. Bates.....Feb. 3, 1903
719,436—J. W. Champion.....Feb. 3, 1903
720,270—T. Martin.....Feb. 10, 1903
720,795—F. X. Fleck.....Feb. 17, 1903
720,817—L. L. Kennedy.....Feb. 17, 1903
721,389—M. Reid.....Feb. 24, 1903
722,284—L. Cesna.....Mar. 10, 1903
722,353—G. A. Bates.....Mar. 10, 1903
722,354—G. A. Bates.....Mar. 10, 1903
723,073—J. S. Thompson.....Mar. 17, 1903
725,861—C. Muehleisen.....April 21, 1903
726,019—S. J. Briden.....April 21, 1903

726,412—P. T. Dodge.....April 28, 1903
727,267—B. F. Bellows.....May 5, 1903
727,914—P. T. Dodge.....May 12, 1903
730,734—G. A. Bates.....June 9, 1903
732,383—J. S. Thompson.....June 30, 1903
732,395—T. Cleghorn.....June 30, 1903
733,559—W. S. Scudder.....July 14, 1903
733,571—J. B. Allen.....July 14, 1903
734,096—J. R. Rogers.....July 21, 1903
734,106—J. S. Thompson.....July 21, 1903
735,121—P. T. Dodge.....July 21, 1903
734,437—W. S. Scudder.....July 21, 1903
734,746—D. A. Poe & W. N. Scharf....July 28, 1903
734,879—P. F. Jones.....July 28, 1903
735,226—J. L. Ebaugh.....Aug. 4, 1903
739,591—J. L. Ebaugh.....Sept. 22, 1903
739,996—P. T. Dodge.....Sept. 29, 1903
740,470—J. R. Rogers.....Oct. 6, 1903
740,471—C. P. Rubly.....Oct. 6, 1903
741,294—H. B. Bartlett.....Oct. 13, 1903
741,957—P. T. Dodge.....Oct. 20, 1903
743,284—J. G. Holbourns & H. A. Longhurst
.....Nov. 3, 1903
744,087—O. Mergenthaler & E. Lawrenz Nov. 17, 1903
744,102—J. A. Proulx.....Nov. 17, 1903
746,415—J. K. Van Valkenberg.....Dec. 8, 1903
747,534—J. Burger.....Dec. 22, 1903
747,832—F. C. L. D'Aix.....Dec. 22, 1903
751,607—J. Broadhouse.....Feb. 9, 1904
752,179—H. Peterson.....Feb. 16, 1904
753,604—W. G. Middleton.....Mar. 1, 1904
754,030—G. A. Venable.....Mar. 8, 1904

754,619—W. R. Speechley.....Mar. 15, 1904
754,970—E. B. Clark.....Mar. 22, 1904
757,099—P. T. Dodge.....April 12, 1904
757,648—S. J. Briden.....April 19, 1904
757,685—D. D. Scott.....April 19, 1904
758,103—W. H. Randall.....April 26, 1904
758,284—P. Shea.....April 26, 1904
759,501—J. M. Cooney & H. L. Totten..May 10, 1904
759,502—J. N. Crofut.....May 10, 1904
761,289—P. T. Dodge.....May 31, 1904

PERFORATED PAPER CONTROLLERS.

320,271—J. E. Munson.....June 16, 1885
320,272—J. E. Munson.....June 16, 1885
364,521—T. Lanston.....June 7, 1887
364,522—T. Lanston.....June 7, 1887
364,523—T. Lanston.....June 7, 1887
364,524—T. Lanston.....June 7, 1887
364,525—T. Lanston.....June 7, 1887
431,280—J. B. Odell.....July 11, 1890
509,860—E. V. Beals.....Dec. 5, 1893
523,760—T. B. Caswell.....July 31, 1894
530,479—G. A. Goodson.....Dec. 4, 1894
530,481—G. A. Goodson.....Dec. 4, 1894
533,848—F. A. Johnson.....Feb. 5, 1895
557,994—T. Lanston.....April 7, 1896
584,360—F. A. Johnson.....June 15, 1897
584,365—F. A. Johnson.....June 15, 1897
584,366—F. A. Johnson.....June 15, 1897
590,763—T. Lanston .....Sept. 28, 1897
596,739—T. B. Caswell.....Jan. 4, 1898
605,954—G. A. Goodson.....June 21, 1898

605,955—G. A. Goodson.....June 21, 1898
605,956—G. A. Goodson.....June 21, 1898
606,007—G. A. Goodson.....June 21, 1898
609,098—G. A. Goodson.....Aug. 16, 1898
625,044—W. A. Lorenz.....May 16, 1899
625,998—J. S. Bancroft.....May 30, 1899
628,620—J. S. Bancroft & W. H. Woods.July 11, 1899
628,631—C. Meray-Horvath.....July 11, 1899
633,088—T. Lanston.....Sept. 12, 1899
648,025—G. A. Goodson.....April 24, 1900
648,116—G. Sandeman & G. M. Brown.April 24, 1900
648,201—G. A. Goodson.....April 24, 1900
652,422—H. Burg.....June 26, 1900
654,115—T. Lanston.....July 17, 1900
663,971—T. Lanston.....Dec. 18, 1900
663,996—T. Lanston.....Dec. 18, 1900
674,362—J. S. Bancroft.....May 21, 1901
674,374—J. S. Bancroft.....May 21, 1901
674,375—J. S. Bancroft.....May 21, 1901
674,376—J. S. Bancroft.....May 21, 1901
688,928—H. Burg.....Dec. 17, 1901
696,732—G. A. Goodson.....April 1, 1902
696,733—G. A. Goodson.....April 1, 1902
696,734—G. A. Goodson.....April 1, 1902
700,288—J. S. Bancroft & M. C. Indahl.May 20, 1902
700,289—J. S. Bancroft.....May 20, 1902
700,290—J. S. Bancroft.....May 20, 1902
700,291—J. S. Bancroft.....May 20, 1902
700,300—A. W. Cathcart.....May 20, 1902
700,301—A. W. Cathcart.....May 20, 1902
700,330—M. C. Indahl.....May 20, 1902
700,336—W. Kemp, Jr.....May 20, 1902

700,341—T. Lanston.....May 20, 1902
702,568—T. Lanston.....June 17, 1902
702,941—G. A. Goodson.....June 24, 1902
705,341—G. A. Goodson.....July 22, 1902
707,522—J. R. Reynolds.....Aug. 19, 1902
707,523—J. R. Reynolds.....Aug. 19, 1902
715,233—W. Ackerman.....Dec. 9, 1902
717,763—C. Rozar.....Jan. 6, 1903
719,375—C. Rozar.....Jan. 6, 1903
720,736—F. H. Pierpont.....Feb. 17, 1903
725,653—J. S. Bancroft.....April 21, 1903
734,576—J. Lagarde.....July 28, 1903
744,230—J. Pinel.....Nov. 19, 1903
745,800—J. M. Dove.....Dec. 1, 1903
751,421—W. T. Stutchbury.....Feb. 2, 1904
752,069—C. J. Hanfbauer.....Feb. 16, 1904
757,319—J. Lagarde.....April 12, 1904
765,057—M. Wehrlin.....July 12, 1904
765,058—M. Wehrlin.....July 12, 1904
765,059—M. Wehrlin.....July 12, 1904
765,775—G. A. Goodson.....July 26, 1904

TRANSFER METHODS.

59,522—P. Flamm.....Nov. 6, 1866
201,436—C. T. Moore.....Mar. 19, 1878
362,987—C. T. Moore.....May 17, 1887
497,914—A. C. Ferguson.....May 23, 1893
602,439—W. Friese-Greene.....April 18, 1898
644,187—C. Sears.....Feb. 27, 1900
644,188—C. Sears.....Feb. 27, 1900
742,523—W. S. Timmis.....Oct. 27, 1903
753,368—R. G. Cornwall.....Mar. 1, 1904

British Patents

Following is a list of patents granted in England on composing machinery. British patents run for a term of fourteen years from date of filing of application, and are granted to the first applicant, without examination, for any improvement new to the realm. Taxes are assessed on British patents, and are cumulative, as follows: Before the expiration of the fourth year, £5; each succeeding year, £1 additional. Provisional patents are granted for a period of nine months, after which they lapse if not perfected. The Government fees are £1 for provisional patents and £3 additional when perfected.

4,664—W. Church.....1822
8,427—E. R. Gaubert.....1840
8,428—J. H. Young & A. Delcambre.....1840
8,726—J. Clay & F. Rosenborg.....1840
9,300—J. Clay & F. Rosenborg.....1842
9,731—J. Mazzini.....1843
11,451—B. Beniowski.....1846
12,421—W. Martin.....1849
1,287—W. H. Mitchel.....1853
1,639—J. T. Boule & F. Caillaud.....1853
2,148—M. Poole.....1853
202—A. C. de Simencourt.....1854
1,548—M. Wiberg.....1854

886—L. P. Coulon 1856
1,871—W. E. Newton 1856
2,444—I. Delcambre 1856
3,089—T. Alden 1856
155—W. H. Mitchel 1857
1,794—R. Hattersley 1857
231—R. Cunningham 1858
1,341—J. H. Young 1858
1,758—R. Cunningham 1858
889—J. H. Young 1859
2,514—T. W. Gilmer 1859
650—J. H. Young 1860
1,769—J. H. Young 1860
2,531—C. W. Felt 1861
771—J. Cummings 1862
697—W. Young 1863
1,403—P. Flamm 1864
1,252—A. Mackie, H. Garside & J. Salmon 1865
1,271—A. A. Low et al 1865
1,845—A. Mackie & J. P. Jones 1865
2,135—A. & W. Young 1865
2,303—A. Mackie & J. P. Jones 1865
3,104—A. Mackie 1865
1,496—I. Delcambre 1866
2,303—A. Mackie 1866
2,425—J. A. Gray & S. W. Green 1866
2,704—A. Corey & J. M. Harper 1866
3,396—A. Mackie 1866
2,164—A. Mackie 1867
2,432—P. Kniaghininsky, P. Galahoff & N. Ossipoff 1867
3,164—J. Thorne 1867

3,366—A. Mackie.....1867
1,984—A. Mackie.....1868
3,728—A. Mackie.....1868
1,921—L. H. Fountaine.....1869
2,031—C. Kastenbein.....1869
3,358—O. L. Brown.....1869
3,679—L. H. Fountaine 1869
725—J. T. Slingerland.....1870
321—R. Winder.....1871
410—J. T. Slingerland.....1871
600—D. B. Thompson.....1871
996—A. Mackie.....1871
2,488—V. E. Mauger.....1871
552—R. Hattersley.....1872
706—J. W. Paige & D. Reynolds.....1872
1,060—A. Fraser 1872
2,111—C. S. Westcott 1872
2,481—M. Gally.....1872
2,563—S. D. Speery.....1872
2,768—L. Heinemann & M. L. Muller.....1872
3,461—A. Fraser.....1872
3,852—A. Mackie.....1873
477—J. Hooker.....1874
1,899—A. Millar.....1874
2,510—A. Mackie & E. H. Waldenstrom.....1874
3,137—R. Winder 1874
3,721—W. N. Smith.....1874
74—R. Winder.....1875
1,566—R. Hattersley.....1875
1,812—A. Fraser 1875
2,073—G. Chapman.....1875
2,649—A. C. Richards.....1875

2,965—C. S. Westcott.....1875
525—L. Heinemann.....1876
567—W. D. C. Pattyson.....1876
1,255—S. W. Green.....1876
1,670—M. L. Muller.....1876
2,005—J. Hooker.....1876
2,800—R. Hattersley.....1876
4,401—L. Heinemann.....1876
329—G. P. Drummond.....1877
2,209—E. A. Cowper.....1877
2,737—D. Reynolds.....1877
3,055—A. Fraser.....1877
3,103—A. C. Richards.....1878
94—J. North.....1879
950—F. Wicks.....1879
1,640—F. Wicks.....1879
2,808—O. Eisele.....1879
3,925—C. G. Fischer & A. von Langen.....1879
3,978—J. Leber.....1879
4,856—R. Winder.....1879
1,503—G. D. Macdougal, W. Adie, G. R. Adams & P. Fleming.....1880
356—T. J. Porter.....1880
510—H. Hilfiker.....1880
3,098—J. G. Thoma.....1880
3,308—J. Dittrich & P. Gantz.....1880
3,345—F. Wicks.....1880
3,623—J. Dittrich & P. Gantz.....1880
3,934—J. Thorne.....1880
1,462—F. Wicks.....1881
1,669—E. W. Brackelsberg.....1881
2,674—I. Delcambre.....1881

3,477—T. Reeve 1881
3,780—J. E. Munson 1881
4,229—C. G. Fischer & A. von Langen..... 1881
4,924—J. A. Marquez 1881
5,127—H. A. Burr 1881
1,260—H. Hagemann 1882
1,316—J. Liwczak 1882
3,979—E. W. Bracklesberg 1882
4,258—L. K. Johnson & A. A. Low..... 1882
4,560—I. Delcambre & V. Riesz 1882
5,004—E. Saule & M. Durozoi 1882
997—F. C. Wyvill 1883
1,655—C. H. Davids..... 1883
2,981—F. B. y Ortiz..... 1883
3,733—M. H. Dement 1883
3,734—M. H. Dement 1883
3,785—P. P. y Albizu..... 1883
246—H. & T. G. Daw 1884
4,160—C. F. Hilder & S. J. A. Cotterell..... 1884
5,490—J. H. Johnson 1884
6,318—C. G. Fischer & A. von Langen..... 1884
6,581—T. G. Daw & H. Daw 1884
9,800—A. J. Barker 1884
10,139—C. G. Fischer & A. von Langen..... 1884
10,525—A. Fraser 1884
10,718—M. H. Dement 1884
11,670—O. Mergenthaler 1884
12,784—F. Wicks 1884
13,577—H. J. Haddan 1884
15,368—M. A. P. & H. M. J. Oudin &
E. Codignola..... 1884
761—M. H. Dement..... 1885

1,151—J. H. White & J. O. Clephane.....1885
1,153—J. H. White & J. O. Clephane.....1885
1,833—O. Mergenthaler 1885
2,571—A. Lagerman 1885
2,688—E. W. Brackelsberg 1885
2,729—E. Wright 1885
2,823—O. Mergenthaler 1885
7,417—C. G. Fischer.....1885
7,635—J. E. Munson.....1885
8,457—O. Mergenthaler 1885
8,995—W. Dreyer 1885
9,454—E. Codignola 1885
10,926—W. H. Knowles.....1885
11,648—W. H. Knowles.....1885
4,657—G. W. Baldrige 1886
7,738—H. C. Leland.....1886
9,115—O. Mergenthaler 1886
10,522—J. L. McMillan.....1886
10,523—J. L. McMillan.....1886
10,525—O. Mergenthaler 1886
11,960—A. von Langen & C. G. Fischer.....1886
15,470—P. D. Hedderwick.....1886
5,271—J. D. Dallas 1887
5,893—H. Hagemann 1887
6,840—A. Lagerman 1887
8,183—T. Lanston 1887
14,517—J. Thorne 1887
14,518—J. Thorne 1887
14,519—J. Thorne 1887
2,066—A. Lagerman 1888
3,270—R. Winder 1888
3,918—J. Thorne 1888

7,912—E. Wentscher 1888
8,178—J. S. Scott & A. Carroll 1888
10,736—J. R. Rogers 1888
13,378—R. Winder 1888
18,058—L. Dow & D. Powers 1888
92—M., R. L. & A. M. Hattersley 1889
7,146—P. P. Craven 1889
7,147—P. P. Craven 1889
12,617—Thorne Typesetting Machine Co. 1889
14,418—J. F. Higgins 1889
14,918—R. Clay & J. E. Marchant 1889
15,829—L. Dow 1889
16,162—Thorne Typesetting Machine Co. 1889
17,614—G. A. Goodson 1889
20,968—J. B. Odell 1889
4,264—W. J. Howell 1890
4,911—J. R. Topliss 1890
5,577—D. Pitcairn 1890
5,582—O. Mergenthaler 1890
7,403—J. W. Chadwick 1890
7,455—G. A. Goodson 1890
8,093—J. B. Odell 1890
9,677—G. A. Botton 1890
11,439—A. J. Kletzker 1890
13,424—J. B. Odell 1890
13,427—J. B. Odell 1890
13,740—R. H. St. John 1890
14,582—National Typographic Co. 1890
15,060—J. R. Rogers & F. E. Bright 1890
15,799—J. G. Retaux & J. A. Medawar 1890
16,391—G. Dillberg & J. A. Philp 1890
19,045—G. A. Botton 1890

19,529—A. Fraser.....1890
20,984—G. Corsa.....1890
21,128—J. Hooker.....1890
130—E. P. Sherwood.....1891
672—V. Landsberg & P. Kohler.....1891
2,344—F. A. Johnson & W. E. Crane.....1891
3,361—Electric Typograph Co.....1891
3,818—T. C. Hargrave.....1891
5,274—E. C. Standiford & S. A. Hyers.....1891
5,971—P. T. Dodge.....1891
7,329—F. Wicks.....1891
9,260—J. Gustafson.....1891
10,620—J. H. Kerridge, C. E. Lane & A. Lane...1891
13,120—E. V. Beals.....1891
13,728—J. S. Scott & F. B. Mills.....1891
15,799—T. G. & H. Daw.....1891
17,380—J. A. Kay.....1891
18,521—J. G. Retaux & J. A. Medawar.....1891
19,129—F. Wicks.....1891
20,519—Tachytype Manufacturing Co.....1891
20,920—J. L. McMillan.....1891
21,373—J. B. Odell.....1891
22,637—H. C. Leland.....1891
22,684—J. L. McMillan.....1891
3,040—Chicago Matrix Machine Co.....1892
3,110—J. A. Hooker.....1892
7,139—J. C. Fowler.....1892
10,324—C. Sears.....1892
11,165—J. Place.....1892
13,524(a)—C. F. Hilder.....1892
13,524—C. F. Hilder.....1892
14,548—J. Place.....1892

17,236—T. T. Heath & A. N. Verdin.....1892
17,606—J. Place.....1892
19,642—R. A. Blake.....1892
20,094—A. J. Kletzker & J. G. Goesel.....1892
20,131—A. W. Maynes.....1892
299—F. Praunnegger & H. L. B. Toobe.....1893
754—C. Sears.....1893
3,425—E. & H. Warburton.....1893
6,914—H. D. Fitzpatrick.....1893
6,938—J. I. Haynes.....1893
10,002—G. W. Hart.....1893
11,621—W. W. & J. M. Bishop.....1893
14,624—C. F. Hilder.....1893
16,200—W. S. Scudder.....1893
17,135—W. S. Scudder.....1893
17,853—C. Meray-Horvath.....1893
21,143—C. Sears.....1893
21,614—B. R. Banks.....1893
23,849—F. W. Schulze.....1893
23,940—J. Place & E. Girod.....1893
24,288—F. E. Bright.....1893
4,986—F. Wicks.....1894
6,541—J. Salomon.....1894
7,065—M., A. M. & R. L. Hattersley.....1894
8,258—M. H. Whittaker.....1894
8,504—A. Fraser & F. Rose.....1894
9,101—E. Werner.....1894
9,384—O. V. Sigurdsson.....1894
9,951—H. W. Libbey.....1894
10,167—C. F. Hilder.....1894
10,257—M. H. Whittaker.....1894
10,348—V. Calendoli & A. Savarese.....1894

10,349—V. Calendoli & A. Savarese.....1894
10,921—J. L. McMillan.....1894
13,351—L. K. Johnson & A. A. Low.....1894
14,695—L. K. Johnson & A. A. Low.....1894
17,517—A. Vorreiter & E. Mullendorff.....1894
18,916—A. E. Vorreiter & E. Mullendorff.....1894
19,026—J. W. Paige.....1894
19,200—J. Salomon.....1894
20,788—J. C. Fowler.....1894
21,335—Cox Typesetting Machine Co. 1894
21,728—A. S. Capehart.....1894
22,428—L. K. Johnson & A. A. Low.....1894
22,921—C. Holliwell.....1894
23,130—E. Girod.....1894
23,471—C. L. Ireland & J. Place.....1894
23,684—G. A. Goodson.....1894
24,603—P. T. Dodge.....1894
24,604—P. T. Dodge.....1894
24,605—O. Mergenthaler.....1894
24,702—O. Mergenthaler.....1894
24,870—J. Place.....1894
473—J. C. Fowler.....1895
1,389—F. J. Wich.....1895
2,549—E. Girod & W. C. Thomason.....1895
2,554—Tachytype Manufacturing Co.....1895
3,009—W. Fletcher.....1895
3,574—Cox Typesetting Machine Co.....1895
4,037—C. Meray-Horvath.....1895
4,119—C. Meray-Horvath.....1895
4,754—E. Wentscher.....1895
5,718—Tachytype Manufacturing Co.....1895
6,336—A. H. Alexander.....1895

7,114—J. R. Rogers.....1895
8,075—P. T. Dodge.....1895
8,076—O. Mergenthaler.....1895
8,077—C. P. Woodruff.....1895
8,078—C. Skatulla.....1895
8,079—P. L. Ripson.....1895
8,133—V. Calendoli & A. Savarese.....1895
8,290—C. Sears.....1895
8,646—C. F. Hilder.....1895
9,334—T. P. Ritzema.....1895
9,438—L. M. Ireland.....1895
9,732—C. L. Ireland.....1895
9,858—National Typographic Co.....1895
9,859—National Typographic Co.....1895
10,374—J. Place 1895
10,581—A. A. Low.....1895
10,590—L. F. Mather.....1895
10,591—C. Muehleisen.....1895
10,592—P. T. Dodge.....1895
10,593—P. T. Dodge.....1895
10,594—P. T. Dodge.....1895
11,644—P. T. Dodge.....1895
11,645—O. Mergenthaler.....1895
12,552—National Typographic Co.....1895
12,971—C. L. Ireland.....1895
13,117—S. H. & P. E. Hodgkin.....1895
13,591—F. J. Wich.....1895
13,592—J. Place & H. Pearce.....1895
13,714—F. J. Wich.....1895
13,890—Stenotype Co.....1895
14,047—C. L. Ireland & F. J. Wich.....1895
14,366—E. W. Wentscher.....1895

14,453—Forth Graphotype Co.....1895
15,606—J. J. Reifgraber.....1895
15,700—Linotype Co.....1895
15,948—Mergenthaler Linotype Co.....1895
16,612—Linotype Co.....1895
16,623—F. E. Bright.....1895
16,752—P. T. Balls.....1895
17,816—O. Mergenthaler.....1895
17,817—O. Mergenthaler.....1895
17,955—W. Fletcher.....1895
17,990—H. R. Rogers.....1895
18,886—P. T. Dodge.....1895
19,118—E. G. Leonard.....1895
20,318—C. L. Ireland & F. J. Wich.....1895
21,452—W. Wynne.....1895
22,478—F. Holdsworth.....1895
22,584—Cox Typesetting Machine Co.....1895
23,590—T. H. Catherall.....1895
24,154—L. K. Johnson & A. A. Low.....1895
25,937—J. Place.....1895
26,648—E. Girod.....1895
26,649—P. C. Lawless.....1895
28,078—G. A. Bates.....1895
28,079—Mergenthaler Linotype Co.....1895
28,080—B. L. Fairchild.....1895
28,081—Mergenthaler Linotype Co.....1895
28,399—T. H. Catherall.....1895
2,009—C. F. Hilder.....1896
2,558—T. T. Heath.....1896
2,559—T. T. Heath.....1896
2,857—C. L. Ireland & F. J. Wich.....1896
2,934—C. Meray-Horvath.....1896

3,114—J. West.....1896
3,126—National Typographic Co.....1896
3,293—National Typographic Co.....1896
3,294—National Typographic Co.....1896
5,621—C. L. Ireland & F. J. Wich.....1896
6,170—C. L. Ireland & F. J. Wich.....1896
6,845—S. H. & P. E. Hodgkin.....1896
7,399—Lanston Monotype Machine Co.....1896
8,166—National Typographic Co.....1896
8,302—National Typographic Co.....1896
13,237—L. K. Johnson & A. A. Low.....1896
14,878—Prinetti Stuechi & Co. & G. Ricchieri...1896
15,607—J. J. Reifgraber.....1896
18,227—F. B. Converse.....1896
18,718—H. Burg.....1896
19,878—J. T. Boyes.....1896
26,636—A. Dow.....1896
505—J. Place.....1897
506—W. H. Lock & J. Place.....1897
3,168—J. Reed.....1897
4,517—F. J. Wich.....1897
4,518—National Typographic Co.....1897
4,766—National Typographic Co.....1897
5,006—F. Wicks.....1897
5,436—H. Pearce.....1897
5,570—Cox Typesetting Machine Co.....1897
6,580—E. W. Brackelsberg.....1897
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7,510—A. S. Capehart.....1897
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9,568—J. Place.....1897

9,569—E. Girod.....1897
9,570—R. C. Elliott.....1897
11,115—Cox Typesetting Machine Co.....1897
12,213—C. Holliwell.....1897
12,214—E. Girod.....1897
12,960—W. H. Lock.....1897
13,267—Lanston Monotype Machine Co.....1897
13,891—C. Meray-Horvath.....1897
14,451—Johnson Typesetter Co.....1897
15,580—C. Sears.....1897
16,254—W. J. Thorneloe & I. J. Hardy.....1897
16,590—L. K. Johnson & A. A. Low.....1897
17,469—F. Wicks.....1897
18,032—Electric Compositor Co.....1897
18,033—Electric Compositor Co. 1897
18,868—W. S. Scudder.....1897
18,938—G. W. Mascord.....1897
18,939—G. W. Mascord.....1897
20,000—A. H. Alexander.....1897
20,035—L. K. Johnson & A. A. Low.....1897
20,130—P. B. W. Kershaw.....1897
21,298—W. J. Lewis, H. Pearce & C. Holliwell..1897
21,299—W. J. Lewis, H. Pearce & C. Holliwell..1897
22,208—Lanston Monotype Machine Co. 1897
22,945—T. H. Catherall.....1897
23,476—C. Sears.....1897
24,114—J. T. Boyes.....1897
24,363—G. Sandeman & G. M. Brown.....1897
24,713—E. L. Booty.....1897
27,216—A. S. Pegler.....1897
27,630—Monoline Composing Co.....1897
28,704—F. H. Pierpont.....1897

28,705—F. H. Pierpont.....1897
29,236—J. Ryder.....1897
29,879—I. Hall.....1897
30,575—T. P. Ritzema.....1897
30,640—Impresa Macchina Compositrice Lamonica Garlanda & Co.....1897
30,656—C. Sears.....1897
668—M. W. Smith.....1898
1,273—M. H. Whittaker.....1898
1,905—W. H. Lock, P. C. Lawless & R. Chambers.....1898
1,979—E. B. Kirby.....1898
1,980—E. B. Kirby.....1898
2,138—National Typographic Co.....1898
2,139—P. C. Lawless.....1898
2,904—J. Place & M. Barr.....1898
3,085—M. Barr & W. J. Lewis.....1898
3,135—A. S. Pegler.....1898
3,168—T. P. Ritzema.....1898
3,921—G. H. Law & W. Ingle.....1898
4,379—J. T. Boyes.....1898
4,977—T. Cahill.....1898
5,824—G. H. Law & W. Ingle.....1898
7,541—W. H. Lock & J. Place.....1898
7,786—T. P. Ritzema.....1898
7,867—L. Paris.....1898
8,228—W. H. Lock et al.....1898
8,269—F. Wicks.....1898
8,586—T. P. Ritzema.....1898
8,722—W. H. Lock & B. Nadall.....1898
9,246—H. Burg.....1898
11,033—Mergenthaler Linotype Co.....1898

11,238—Cox Typesetting Machine Co.....1898
11,239—Cox Typesetting Machine Co.....1898
11,402—W. H. Lock, B. Nadall & M. Barr.....1898
11,615—W. H. Lock, J. Place & W. J. Lewis..1898
13,246—T. Cahill.....1898
13,922—J. S. Duncan.....1898
14,781—C. Sears.....1898
15,345—H. J. S. Gilbert-Stringer.....1898
15,923—W. H. Lock, C. Holliwell & W. J. Lewis.1898
16,254—C. Muehleisen.....1898
16,255—C. Muehleisen.....1898
17,302—C. W. Dickinson.....1898
17,962—J. R. Rogers.....1898
19,234—W H. Lock, F. C. Dolby & W. Tattersall.1898
19,713—C. Muehleisen.....1898
20,641—W. H. Lock, W. R. Speechley & A. E. Barlow.....1898
22,456—H. Burg.....1898
23,709—F. Wicks.....1898
23,761—W. H. Lock & H. J. Gardner.....1898
24,011—Mergenthaler Linotype Co.....1898
24,012—Mergenthaler Linotype Co.....1898
24,305—P. E. Hodgkin & W. May.....1898
24,624—Thorne Typesetting Machine Co.....1898
27,273—C. Sears.....1898
27,581—National Typographic Co.....1898
27,582—W. J. Ennisson.....1898
375—C. A. Albrecht.....1899
617(a)—W. H. Lock & P. C. Lawless.....1899
617—W. H. Lock et al.....1899
1,587—F. B. Converse.....1899
2,181—W. E. Bertram.....1899

2,720—Mergenthaler Linotype Co. 1899
2,721—W. H. Lock & F. J. Wich 1899
3,368—A. E. Dowell 1899
4,052—F. Wicks 1899
4,351—I. Risley 1899
4,440—G. Fischer 1899
5,227—A. Fraser & F. Rose 1899
5,632—H. J. S. Gilbert-Stringer & F. Wicks . . . 1899
6,143—H. J. Derbyshire 1899
6,459—W. H. Lock & E. Girod 1899
6,927—A. Savarese & J. D. C. Chateau 1899
7,691—A. Kraus 1899
8,633—Lanston Monotype Machine Co. 1899
8,634—Lanston Monotype Machine Co. 1899
9,643—W. H. Lock, M. Barr & H. Isherwood . . 1899
9,644—W. H. Lock & F. Mosley 1899
9,645—W. H. Lock, B. Nadall & W. G. White . . 1899
9,951—W. H. Lock & W. Heap 1899
11,410—W. H. Lock, C. Holliwell & W. J. Lewis . 1899
11,778—D. Murray 1899
12,217—F. C. F. Knaak & J. S. Campbell 1899
12,530—P. E. Hodgkin & G. E. Kenney 1899
13,168—J. R. Rogers 1899
14,301—C. J. Botz 1899
14,400—H. Burg 1899
15,575—E. F. Linke 1899
16,145—C. J. Botz 1899
16,268—W. H. Lock & F. J. Wich 1899
16,660—E. F. Nydahl 1899
17,060—H. C. von Hoyweghen 1899
17,569—F. C. F. Knaak & J. S. Campbell 1899
18,592—F. McClintock 1899

17,875—I. Hall.....1899
18,228—W. H. Lock & F. J. Wich.....1899
18,638—Lanston Monotype Machine Co.....1899
18,991—W. H. Lock et al.....1899
21,170—W. H. Lock & W. C. Pritchard.....1899
22,294—F. McClintock.....1899
23,722—A. Dow 1899
23,980—J. R. Rogers.....1899
24,508—Mergenthaler Linotype Co.....1899
24,890—F. B. Converse.....1899
25,472—J. R. Rogers.....1899
482—W. H. Lock & J. Broadhouse.....1900
1,152—Unitype Co.....1900
1,610—G. K. Garvin.....1900
1,882—C. Sears.....1900
1,903—H. J. S. Gilbert-Stringer.....1900
1,960—C. Sears.....1900
3,390—H. Dundas & P. B. W. Kershaw.....1900
3,541—E. B. Kirby.....1900
3,618—W. C. Trownsell & J. R. Trego.....1900
3,955—M. H. Whittaker & C. H. West.....1900
4,123—F. Lucke.....1900
4,734—P. H. McGrath.....1900
4,808—W. H. Doolittle.....1900
4,963—A. H. Bates.....1900
4,967—A. H. Bates.....1900
5,054—G. A. Goodson.....1900
5,275—E. V. Beals & F. A. Gray.....1900
5,884—W. H. Lock & F. J. Wich.....1900
6,299—W. H. Lock & H. Brown.....1900
6,692—W. H. Lock, C. Holliwell & R. C. Elliott.1900
7,141—E. Liley & W. H. Cullen.....1900

8,096—E. F. Nydahl & G. A. Harling.....1900
9,288—B. M. Des Jardines.....1900
9,345—C. Rosinkiewicz & L. Ramult.....1900
9,357—Monoline Composing Co.....1900
9,431—E. Wentscher.....1900
9,627—W. H. Lock & W. Fletcher.....1900
9,628—W. H. Lock & H. L. Cox.....1900
9,915—A. A. Low.....1900
11,285—E. Mullendorff.....1900
11,492—F. Wicks.....1900
11,568—Thorne Typesetting Machine Co.....1900
13,345—R. H. St. John.....1900
16,584—H. Pendlebury.....1900
17,026—National Typographic Co.....1900
17,550—J. Kuhn & J. Lopez.....1900
18,542—C. Rozar.....1900
20,178—E. Maruhn & E. Uhthoff.....1900
20,953—H. J. S. Gilbert-Stringer.....1900
21,699—W. H. Lock & W. Fletcher.....1900
22,107—W. H. Lock & C. Holliwell.....1900
22,674—A. Reveille.....1900
23,114—Lanston Monotype Machine Co.....1900
23,115—Lanston Monotype Machine Co.....1900
23,205—W. H. Lock, H. Pendelbury & W. H. Thomas.....1900